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CIVIL ENGINEERING.

Strength of Cisterns and Tie-Rods. WEBB *v.* TOWNS.—*Arbitration.*[*]

The facts of this case are shortly these:—The plaintiff, Mr. Webb, is an extensive malt distiller, carrying on business at West Ham, Essex, and employed the defendant, Mr. Towns, a back-maker, to construct for him a number of wash-backs or cisterns of very large dimensions, constructed to contain the wort or wash, similar to the fermenting tuns at breweries. The plaintiff undertook to provide the iron tie-rods ready for fixing; the defendant was to fix the rods so provided, and provide and fix the timber work. One of these wash-backs (No. 8) suddenly burst in March, 1851, on which occasion the wash, valued at about 300*l.* was lost, and damage to the amount of 341*l.* 15*s.* 8*d.*, was alleged to be done to the premises and plant by the accident. The inside dimensions of the back were:—length, 30 feet; breadth, 20 feet; depth, 13 feet; contents, 40,000 gallons = 1328 barrels = 216 tons weight of fluid; and constructed of Dantzic fir, 3-inch sides, 2-inch bottom, spiked to sides, braced horizontally with three tiers of 1¼-inch tie-rods, longitudinal and transverse, *hooked* together in the middle, with fir cleets and tie-planks; in addition to which were iron bolts passing vertically through the entire thickness of the sides, besides dog-bolts at angles.

The plaintiff's witnesses, consisting of Messrs. Curtis, the builders, and men in their employ, gave evidence that the ties were improperly placed in the back, as regards heights or distances from the bottom; that the

[*] From the London Builder, No. 476.

rods, 1¼ common English iron, *hooked together in the manner as ordered by plaintiff, were tested by hydraulic pressure to the extent of* 25 *tons, without breaking*. Mr. Deely, engineer, gave evidence that the tie-rods were improperly placed, and on some other points of construction. Mr. John Braithwaite, civil engineer, gave evidence to the like effect, that the iron tie-rods were sufficient for the purpose; calculated the pressure that possibly could be on the bolts or tie-rods, and found it less than one-half what the bolts ought to stand; was convinced the cause was not the bursting of the bolts, but that this was the consequence; found the back slightly put together; the tie-rods were too far from the bottom, throwing too much pressure on the wood-work of the bottom, the dog-bolts too slight. He concluded that the back gave way in the first instance at the bottom, giving motion to the fluid within, and, according to the degree in which it gave way, *would increase the pressure probably from* 10 *tons up to* 40 *or* 50 *tons, depending on the velocity of the fluid*, and in his opinion was the cause of the accident. The weight on the tie-bolts could not have broken them, even to 20 tons; the breaking strength of the iron was nearer 30 than 20 tons: *did not object to the tie-bolts being hooked.*

Calculated pressure on side upper tier of bolts—

	4 at 3¼ tons each, . .	13 tons.
Middle 4	6½	26
Lower 4	9¾	39
	Total tons, . .	78

For the defendant.—His workmen and fellow-tradesmen gave evidence that the materials and workmanship were good, and the backs were constructed in the ordinary and common way—excepting as regarded the method of connecting the tie-rods together in the middle, which, by the special direction and interference of plaintiff, were hooked together, instead of being connected by eye-bolts—and they likewise spoke to the bad quality of the iron, (common English,) which, in turning to form the hook, broke several times.

Mr. Charles Humphreys, surveyor, gave evidence.—The back was constructed in the customary way; that after the accident the side was bulged and convex on the outside, the cleets broken outwardly; that the point of the greatest convexity was in the lowest tier of tie-rods, and that the rupture of the side tore away the bottom, and that the cause of the accident was insufficiency of the tie-rods both as regards the quality of material and the method of connexion, by means of hooks; that all iron loses 75 per cent. of its strength by being hooked, (as shown in a series of experiments instituted especially for the purposes of this trial, by Mr. Heather, M. A. of the Royal Military Schools, with the proving machine, at the dockyard, Woolwich;) that by calculation the pressure on the entire side of the vat was 70 tons; and, deducting for the duty done by the bottom and sides, there would be a pressure of 6 tons on each tie-rod, supposing it possible to insulate each rod, but the side being made rigid, it was not possible so to do; that the tie-rods were equal to a strain of 2 tons only, and broke with 6¼, as shown by experiment; that after the bursting, the pressure of the fluid on the back would rapidly diminish, and would not increase.

Mr. Heather, M. A. of the Royal Military Academy, Woolwich, by a working model proved that, if any fluid issues from an aperture in the side of a vessel, the pressure on that side is diminished, being consumed in the motion of the fluid; that the principle of hooking ties together is essentially bad, in consequence of the cross strain on the fibres of the iron, to the amount of 75 per cent. on all iron; and that the accident occurred in consequence of the insufficiency of the iron tie-rods, as regards quality and construction.

Mr. Davidson, Civil Engineer, gave evidence in confirmation of the above.

The inquiry lasted nine days, and the arbitrator gave his award for the defendant.

The points of this case are especially interesting as regards the common method of hooking ties together, thereby causing a loss of strength, and the wide discrepancy between the experiments performed at *Woolwich Dockyard* and by the *ordinary testing machines at foundries.*

Experiments made at H. B. M. Dockyard, Woolwich, with Messrs. Bramah's Hydraulic Press, in January, 1852, showing the weakness of hooks.

COMMON ENGLISH ROUND IRON, 1 3-16 INCHES DIAMETER.

No. 1.—Hooked.

Strain of 4 tons, no effect.
" 5 " opened $\frac{1}{8}$ of an inch.
" $5\frac{1}{2}$ " " $\frac{1}{4}$ "
" 6 " " $\frac{3}{8}$ "
" $6\frac{1}{4}$ " " $\frac{1}{2}$ "
" $6\frac{1}{2}$ " " $\frac{5}{8}$ "
" $6\frac{3}{4}$ " " 13-16 "
" 7 " " 15-16 "
" $7\frac{1}{4}$ " broke.

No. 2.—Straight (same piece).
Strain of 10 tons, no effect.
" 16 " "
" 18 " lengthened 5-16 in 2 ft.
" 20 " " 11-16 "
" 21 " " 15-16 "
" 22 " " $1\frac{1}{8}$ "
" 23 " " 1 7-16 "
" 24 " " $1\frac{3}{4}$ "
" 25 " " 2 3-16 "
" 26 " " 3 1-16 "
" $26\frac{7}{8}$ " broke.

No. 3.—Hooked open $1\frac{3}{8}$.
Strain of $5\frac{1}{2}$ tons, no effect.
" 6 " opened $\frac{1}{8}$
" $6\frac{1}{2}$ " " 5-16
" $6\frac{3}{4}$ " " $\frac{3}{8}$
" 7 " " $\frac{1}{2}$
" $7\frac{1}{4}$ " " $\frac{5}{8}$
" $7\frac{1}{2}$ " " $\frac{3}{4}$
" $7\frac{3}{4}$ " " $\frac{7}{8}$
" $7\frac{7}{8}$ " broke.

No. 4.—Straight (same piece as No. 3).
Strain of 16 tons, no effect.
" 18 " lengthened 5-16 in 2 ft.
" 20 " " $\frac{3}{4}$ "
" 21 " " 1 "
" 22 " " $1\frac{1}{4}$ "
" 23 " " $1\frac{1}{2}$ "
" 24 " " $1\frac{7}{8}$ "
" 25 " " $2\frac{3}{8}$ "
" 26 " " $3\frac{1}{8}$ "
" $26\frac{5}{8}$ " broke.

S. C. CROWN IRON, 1 3-16 INCHES DIAMETER.

No. 5.—Hooked, $1\frac{1}{4}$ open.
Strain of 5 tons, opened 3-16
" 6 " " $\frac{1}{2}$
" $6\frac{1}{2}$ " " $\frac{1}{2}$
" 7 " " $\frac{7}{8}$
" $7\frac{1}{2}$ " " 1 1-16
" 8 " " $1\frac{1}{2}$
" $8\frac{1}{4}$ " straightened out.

No. 6.—Straight (same piece).
Strain of 15 tons, no effect.
" 17 " 11-16 in 2 feet.
" 20 " 1 "
" 22 " $1\frac{1}{2}$ "
" 24 " $2\frac{1}{4}$ "
" 26 " $6\frac{3}{4}$ " reduced to $\frac{7}{8}$ diameter and broke.

BEST MITRE IRON, 1⅛ INCHES DIAMETER.

No. 7.—Linked.

Strain of 15 tons, stretched ¼ in 3 feet.
" 16 " " 3-16 "
" 17 " " ½ "
" 18 " " 11-16 "
" 19 " " 1 "
" 20 " " 1¼ "
" 21 " " 1⅜ "
" 22 " " 2 "
" 23 " broke.

No. 8.—Straight (same as No. 7).
Strain of 23 tons, stretched 3-16
" 24 " " 7-16
" 25 " " ¾ broke.

No. 9.—Same as No. 7, linked.
Strain of 15 tons, stretched ¼ in 3 feet.
" 16 " " ¼ "
" 17 " " ½ "
" 18 " " ⅝ "
" 19 " " ¾ "
" 20 " broke.

No. 10.—Straight.
Strain of 20 tons, no effect.
" 21 " stretched 1-16
" 22 " " ¼
" 23 " " ⅜
" 24 " " 9-16
" 25 " " 1
" 25½ " broke.

MR. WEBB'S IRON, 1 3-16 INCHES DIAMETER.

No. 11.—A Double Hook.
Strain of 2 tons, 1 hook opened: 2d hook.
" 2 1-16 " none.
" 3 1-16 " 1-16
" 4 broke.

No. 12.

Strain of 2 tons, no effect.
" 3 " 1-16 opened.
" 4 " 3-16 "
" 5 " ½ "
" 6 " 1⅛ "
" 6¼ " broke.

MR. TOWNS' IRON MITRE, ROUND, 1 5-16.

No. 13.—Flat Eye, Hook, and Key.

Strain of 8 tons, no opening.
" 16 " broke at angle.

Note.—As $(1\ 5\text{-}16)^2$ (Iron.) : 16 (Tons.) :: $(1\ 3\text{-}16)^2$ (Iron.) : 13 (Tons.)

No. 14.—Same piece straight.
Strain of 30 tons, stretched 1-16 in 10 in
" $30\frac{1}{8}$ " broke.

Note. As $(1\ 5\text{-}16)^2$: $(1\ 3\text{-}16)^2$ :: 30 (Tons.) : 24 6-11 (Tons.)

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*Experiments with the Submarine Telegraph.**

On Monday last, by permission of the Directors of the Submarine Telegraph between England and France, a series of interesting experiments were made by Mr. Reid, telegraph engineer, of University street, London, for the purpose of testing a pair of double-needle instruments and two new batteries which he had constructed. One of these instruments was placed in the Company's office at Dover, and the other in the French office at Calais, with a battery to each. Two of the submarine wires were then connected with the instruments, and put in circuit with the batteries. The length of the submarine cable in the Channel is about 24 miles, and

* From the London Mechanics' Magazine, for March, 1852.

about five miles of land telegraph on each side, making, in round numbers, a circuit of 68 miles. The battery that was to work this distance formed a strong contrast to the present battery now in use, the length being only 4 inches by 1½ deep, and the weight 1 lb. 5 oz., while the old common battery used on the lines is 36 inches long, 7½ inches wide, 8½ inches deep, and weighs 64 lbs. Some of the telegraph clerks in the office smiled incredulously when Mr. Reid connected the miniature battery with the instrument, but were surprised to find the signals to and from Dover and Calais quite equal to the signals they were receiving from their former batteries. The next experiment was for the purpose of testing an improvement in the double-needle instrument, and will require the utmost stretch of faith on the part of our readers to believe. It was as follows: The miniature batteries were removed from the instruments on each side of the Channel, and a piece of zinc, three-fourths of an inch square, and a piece of silver to correspond, were then introduced into the mouth of the operator at the office in Dover, and instructions sent to do the same at Calais. The wires attached to these pieces of metal were then connected with the instruments, and by this simple means, and by the simplest of all batteries, the telegraph clerks sent several messages to and fro from England to France. The next experiment was similar to this, only a larger piece of zinc and a larger piece of silver were introduced into the mouth of the operator. The result was an improvement of the signals. The next day, March 2, the experiments were repeated with the same success. The instruments with the miniature batteries transmitted all the commercial messages, price of stock, funds, &c., till 1 o'clock, when they were packed up and sent to London. It was thought that during these operations the miniature battery would become exhausted; on the reverse, it improved, and seemed perfectly to maintain its character. From these experiments we may conclude a new revolution is in progress with telegraphs and batteries. They will become more simple, more easy to understand, and will eventually not only become as familiar as household words, but familiar and useful as household servants.

An Account of the Progress made in the Drainage of Haarlem Meer during the last year. *By* T. Grainger, C. E.*

This short paper, in continuation of Mr. Grainger's description of the drainage of Haarlem Meer, in North Holland, was read by the Secretary. After describing the difficulties to be encountered in the prosecution of this great undertaking, from the size of the lake, and principally from the circumstance that its level, even at the surface, was considerably below that of the sea, so that the whole of the water had to be raised to such a height as would enable it to reach the sea by its own gravity, Mr. Grainger alluded, in general terms, to the various works undertaken to effect the object in view, such as the canal, 33 miles long, 124 to 147 feet in width, and 10 feet in depth, with which the lake had been surrounded to convey the pumped-up water to the sea—to receive the drainage of the district—and to maintain the internal water communication

* From the London Civil Engineer and Architect's Journal, April, 1852.

previously afforded by the lake itself—and also to the three gigantic steam engines, 360 horse power each, erected at different points of the lake, giving motion to 27 pumps, which raise 186 tons of water at each stroke. The canal and all the other preliminary works having been completed, the pumping was commenced in May, 1848, from which date to 30th April, 1851, the lake had been lowered 7 feet 3 inches, which was the state of matters when the subject was last brought before the Society. During the months of May, June, July, August, September, and October, very satisfactory progress was made, notwithstanding that a considerable quantity of rain fell in August and September, the level reached at the end of October being 9 feet 7·74 inches below the original surface, or at an average rate of 4·79 inches per month. In November a great quantity of rain and snow fell, raising the level about 4 inches; and in December the weather was still unfavorable, so that at the end of that month the level stood at 9 feet 5·58 inches below the original surface, or a total gain since April 30th of 2 feet 2·58 inches, or 3·32 inches per month. This progress may appear to be inconsiderable; but, when it is recollected that the lowering of the lake one inch involves the raising of upwards of four millions of tons of water, and allowing for the rain and snow falling during these eight months, there could not have been less than 186,000,000 tons of water pumped up during that period, the performance will appear great indeed. To give a better idea of this, it was stated that 186,000,000 tons is equal to a mass of solid rock one mile square and 100 feet high, allowing 15 cubic feet to a ton. The average progress has been less last year than what it was in the preceding one; but this is readily accounted for by the *increased lift* of the pumps, and by the difficulty of forming the channels which lead the water to them. At the commencement of these operations, the average depth of the lake was 13 feet 1·44 inches, and as 9 feet 5·58 inches have been pumped out, there only remained at the end of December last an average depth of 3 feet 7·786 inches. It is therefore trusted that the drainage will be completed, if not in the autumn of this year, at least in the summer of 1853. A paragraph has been going the round of the newspapers about disastrous accidents to the boilers, which will delay the completion of the works for two or three years. It was stated that there were no grounds for such rumors, as the official report for January, which Mr. Grainger had received, mentioned that the boilers of only one of the engines (the Lynden) were out of repair, and that it was expected that these would be repaired by February; so that, by this time, it is hoped that the whole of the engines are again at work.—*Proc. Roy. Scot. Soc. Arts, March* 8, 1852.

AMERICAN PATENTS.

List of American Patents which issued from April 6th to April 27th, 1852, *(inclusive,) with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improved Lock;* Albert Betteley, Boston, Massachusetts, April 6.

Claim.—"What I claim as my invention is, 1st, Holding the tumblers rigidly, so that they cannot be moved when the keyhole is exposed, by means of a cam placed on the same shaft with the cam which moves the bolt.

"2d, I claim so arranging the tumblers with the key, that the tumblers will form themselves into the right position, so that the bolt can be withdrawn, by dropping by their own weight, or being pressed by springs upon the key, as herein above described."

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2. For *Improvements in Saw Mills;* William C. Bronson, Erwin, New York, April 6.

Claim.—"What I claim as my invention is, the construction of a saw frame or gate of metal tubes, constituting the guides as well as the uprights of said frame, and cross pieces c heads united to said uprights, in the manner set forth.

"I also claim the arrangement of the cross hooked bar and hooks on the ends of the saws, in combination with the sustaining side bars and upper open plate, for the purpose and in the manner substantially set forth in the foregoing specification and accompanying drawings."

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3. For *Improvements in Spinning Bait for Catching Fish;* John T. Buel, Whitehall, New York, April 6.

Claim.—"Having thus described my improved revolving fish or fly, I wish it to be distinctly understood that I do not claim what is called a spoon, minner, or the common fly, all these having been used before; but what I do claim as new is, 1st, Constructing a bait with an air-tight chamber, which chamber is provided with an aperture or apertures for the admission of air when fishing light, near or on the surface of the water, and for the admission of water when it is desired to fish deep under the surface of the water, substantially as described.

"2d, I do not claim passing the line loosely through a cork or float, that the float may move freely upon the line; neither do I claim attaching a spinning bait to the line by means of a swivel; but what I do claim is, passing the line through a tube in the body of a spinning bait, in the manner substantially as described, to enable the bait to twirl freely without twisting the line."

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4. For an *Improvement in Stone Cutting Machines;* John W. Cochran, Williamsburg, New York, April 6.

Claim.—"What I claim as my invention is, 1st, Cutter jaws or their equivalent, combined with and carrying a cutter across the stone, in the segment of a circle, the cutter being so set that the part of its periphery in contact with the stone, when cutting, inclines towards, and the part of the periphery opposite thereto, from the axis or centre of motion of the cutter jaws, for the purpose set forth.

"2d, The application of revolving cutters to dressing stone, moving and cutting in a curved line across the stone, and on a convex edge of the undressed portion of the surface formed by the line of cut, and cutting towards the centre of motion of the cutters in such curved line.

"3d, The combination of a rock shaft with cutter jaws, to carry the cutters over and clear from the undressed portion of the stone, substantially as described and for the purposes set forth.

"4th, The combination of the rock shaft, guide table, and friction rollers, and their equivalents, substantially as described and for the purpose set forth.

"5th, The combination of the rock shaft and cam and roller, to produce the rocking or trembling motion, substantially as described."

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5. *For an Apparatus for Closing Doors;* Minard Thurston Cooper, Ballston Spa, New York, April 6.

Claim.—"What I claim as my invention is, the combination of the heavy roller upon a vibrating arm with the turning railway or inclined plane, the former attached to the door, and the latter to the casing, and the whole operating substantially in the manner and for the purpose herein described."

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6. For an *Improvement in Horse Collars;* Henry B. Latham, Huntington, New York, April 6.

Claim.—"1st, I claim the spring 9, and staples 10, to connect the upper ends of the hames, as described and shown.

"2d, I claim so constructing and fitting the collar and hame, that the hame shall work or slide on the collar by any jerk or lurching of the harness, for the purpose of relieving the animal; said collar and hame being fitted with the rivets 1 and 2, or their equivalents, to allow the one to slide on the other, and being connected by the bolts 5, or their equivalents, as described and shown."

7. For an *Improved Method of Attaching Roses for Knobs to Doors, &c.;* Nathan Matthews, Assignor to Richard Edwards, David A Morris, and Nathan Matthews, Pittsburg, Pennsylvania, April 6.

Claim.—"I do not claim the mere employment of a dovetail joint, for securing the circle plate in its place; but I claim as new the combination, substantially as described, of the circle plate, having dovetails on its inner face, the dovetails, which are fast on the door or other object, and the shank or socket of the knob, or what is equivalent, any spindle or shaft, attached to the knob or handle."

8. For an *Improvement in Coat Forms;* William B. Olds, Meriden, Connecticut, April 6.

Claim.—"What I claim as my invention is, the bow, C, substantially as described, suspended by a shank at a point distant horizontally from its vertex, on a pivot or its equivalent, which is stationary in a bracket, or any suitable standard or pendant, so placed or constructed as to allow the bow to turn round in any direction, as and for the purposes herein set forth."

9. For an *Improvement in Moth Traps to Bee Hives;* Ebenezer W. Phelps, Newark, Ohio, April 6.

Claim.—"I claim the peculiar construction of the moth trap as herein described, composed of a slide, having the centre groove and two side grooves, and the metallic hinged cover, arranged all as set forth in the specification."

10. For an *Improvement in Buttons, Studs, &c.;* David Rait, City of New York, April 6.

Claim.—"What I claim as my invention is, making a stud, button, or other similar fastening or article of jewellery, in two parts, one part carrying a tube, and the other part with two snap springs, operating in the manner substantially as set forth."

11. For an *Improvement in Smut Machines;* Daniel Shaw, Cheshire, Ohio, April 6.

"The nature of my invention consists in an improvement, by which the light grain and cheat is perfectly and effectually separated from the smut, dust, chaff, and other impurities, at one single operation."

Claim.—"Having thus fully described the construction and operation of my combined smut and grain separator, what I claim therein as new is, the offset, that is to say, enlarging the space of the hollow trunk on the opposite side thereof from that at which the grain is admitted, in combination with the screen *e*, spout *f*, and the passage and valve *g'*, for taking the dust, &c., into the fan case, whereby the cheat and light grain, which will pass up the spout, with the impurities, is effectually separated, and delivered through the spout *f*, substantially as herein fully set forth."

12. For an *Improved Harpoon;* J. D. B. Stillman, City of New York, April 6.

Claim.—"I do not claim making the flukes separate from the point, or causing the latter to enter deeper than the former into the body of the whale; but what I do claim as my invention is, the combination of the sliding and unlatching flukes with the lance, and the lines, or their equivalents, by means of which the point is driven deeper by the drag or traction on the line, substantially in the manner herein described."

13. For *Improved Mechanism for Actuating an Adjustable Eccentric;* Matthew Stubbs, Cincinnati, Ohio, April 6.

Claim.—"Having thus described the nature of my improvements in the valve gearing of steam engines, I wish it to be understood that I make no claim to an adjustable sheeve,

nor to the use of a screw in this connexion; but what I claim herein as new are, the herein described devices for the adjustment of an eccentric sheeve, that is to say, the sheeve stock, arranged so as to traverse a bed-plate at right angles to the shaft or axle, and operated by a hand bar through the medium of suitable levers, and yoke, connected with a sliding collar, from which projects a rack, which gears into a pinion upon the screw, which actuates the sheeve; and this I claim, whether or not the same be combined with the vibrating arm and shifting pin, as herein represented, for variation of the throw."

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14. For an *Improvement in Grain Separators;* John Thompson, Chili, New York, April 6.

Claim.—"Having thus fully described my improved threshing machine, what I claim therein as new is, the novel arrangement for separating the grain from the straw, by which the slats provided with teeth have a rotary and lateral motion, said motion produced substantially as described, or in any equivalent manner, in combination with the inclined slats, whereby, by their combined action, the grain is perfectly and rapidly separated from the straw, operating in the manner and for the purpose herein fully set forth."

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15. For an *Improvement in Boot Jacks;* Sardis Thomson, Hartsville, Massachusetts, April 6.

Claim.—"Having thus described my invention, what I claim as new is, 1st, The heel gripper and stirrup, in combination with the lever, to draw the stirrup over and hold the toe of the boot, in the manner and for the purpose set forth.

"2d, I claim the movable heel gripper, in combination with the connecting rod and stirrup, constructed and operating substantially the same as described and represented."

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16. For an *Improvement in Seed Planters;* Jesse Urmy, Wilmington, Delaware, April 6.

Claim.—"Having thus fully described my improved machinery for seeding, what I claim therein is, the jointed tooth attached to the beam, as shown in fig. 7, in combination with the swiveling bifurcated spout, to direct the corn as above specified, for ribbed seeding.

"I also claim the combination and arrangement of the counter with the clutch, as described, so that the counting shall stop when the seed is not delivered.

"I also claim the finger register and its appurtenances, as above described, for regulating the quantity of seed delivered.

"I also claim, in combination with the seeding apparatus, the pulverizer, for guano, &c., constructed and arranged as set forth."

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17. For *Improvements in Rails and Car Wheels;* John Valentine, City of New York, April 6.

"My invention consists in a new and improved method of constructing wooden railroads, and carriages adapted to run upon the same."

Claim.—"What I claim, therefore, as my invention is, the guide wheels, in combination with the rail, constructed as described, and the carriage; said wheels having their circumferences beveled, so as to expose two surfaces to roll upon; one to project against the side of the rail, and the other to come in action upon the surface of the inner strip forming part of the chair, when the guide wheels become burthen wheels, as described; the whole being constructed and operating substantially in the manner herein set forth."

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18. For an *Improvement in Cultivators;* T. J. Ball and John Post, Pittsfield, Michigan, April 6.

Claim.—"What we claim as our invention is, the construction of the long metallic inclined blades on the after part of the machine, for cutting the sods and lumps, and pulverizing the ground, as set forth."

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19. For *Improvements in Drop Punches;* Solomon Andrews, Perth Amboy, New Jersey, April 13.

"The nature of my invention consists in the peculiar construction of the drop punch and the mode of lifting and discharging it."

Claim.—"I do not claim constructing the hammer with a long stem, and making the same serve as guides; but I claim as my invention, the hammer or drop, provided at the same time with a stem to serve as one of its guides, and one guide on each side, at or near its lower end, substantially as herein specified.

"I also claim as my invention, the manner of lifting and discharging the hammer, or drop, by means of the cogs in its stem, and the pinion operating therein; the fall of the hammer or drop, bringing the said pinion into gear with the motive power, and its upward motion releasing or discharging it threfrom, at any given point, substantially as herein described."

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20. For *Improvements in Hinges;* William Baker, Utica, New York, April 13.

Claim.—"I do not claim as new, simply constructing the window blind hinge, with its screw plates so arranged as to be secured to the back of the blind and the outside of the window casing; but I claim the bridge or inclined plane at the base of the pin, and the corresponding elongation of the eye, operating upon and in connexion with the hook and catch attached and connected in the manner described; the whole forming a fastening, and the mode of operating the same; the fastening taking hold of, and pulling directly upon the window casing and the blind, and thus relieving the hinge as described.

"I claim the use of the bridge, or inclined plane, at the base of the pin, and the elongation of the eye as described, for disengaging the blind fastening independent of its connexion with my fastening, as above described, and whether the fastening is connected with the hinge or not; the whole being constructed and arranged substantially in the manner above set forth."

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21. For an *Improvement in Machines for Tonguing Boards;* Ransom Crosby & Henry D. Edgecomb, Assignors to Ransom Crosby Jr., City of New York, April 13.

Claim.—"Having thus fully described our apparatus, what we claim therein as new is, the arrangement of two sets of stationary vibrating cutters for tonguing boards in separate stocks, substantially as herein described, with a space between them for the escape of shavings, the sides of the stock being substantially parallel to the face of the board and each other, and the surfaces of their soles being substantially perpendicular thereto, the plane irons being inclined in the usual way, to the soles and backs of the stocks and the cutters, in their length, being substantially parallel to the sides thereof. We are aware that two sets of cutters, in separate stocks, have been differently arranged and for an analogous purpose, and we therefore do not claim them, except in the arrangement and position, substantially as above described."

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22. For *Improvements in the Method of Welding Steel, &c., to Cast Iron;* Mark Fisher and John H. Norris, Trenton, New Jersey, April 13.

Claim.—"Having thus described our improved apparatus for the manufacture of articles of cast iron, with steel or wrought iron welded thereto, what we claim as our invention is, first, the metal box or frame for sustaining the steel in place, and forming the cell below it; and, secondly, securing the steel in place by means of the clamps, in the manner above described."

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23. For *Improvements in Mills for Curvilinear Sawing;* James Hamilton, City of New York, April 13; patented in England, June 1, 1848.

"The invention consists, first, of means of supporting timber, when being cut to various bevels.

"Secondly, The invention consists of chucks, or apparatus, for holding timber at the ends, when being cut or sided, and in supporting such chucks.

"Lastly, The invention consists of improvements in apparatus for indicating the directions or bevels to which timber is to be cut."

Claim.—"What I claim as my invention is, connecting the supporting roller with the lever which forces it up against the under side of the log, by means of a joint and a segment slot, and securing bolt, or the equivalents thereof, substantially as specified, so that the said roller can be inclined in any desired direction from a horizontal line, to suit the inclination of the underside of the log, and there secured, to give efficient support, as set forth.

"I also claim extending the chucks for supporting the ends of curved logs below the head and tail blocks, so that the ends of such logs in siding may be supported below the surface of the head and tail blocks, to bring the upper curved part within the range of motion of the saw, substantially as specified, when this is combined with the middle supporting rail, on which the lower part of the chucks rest, and by which they are supported during the operation, as set forth.

"And, finally, in the method of indicating the bevels and keeping the log to them as it is being sawed, I claim the index hand, whose axis of motion is in a line, or nearly so, with the axis of rotation of the log, substantially as specified, in combination with either of the side levers, which have the same axis of motion as the index hand, and the adjustable or shifting inclined ways, substantially as specified, so that as the carriage advances with the log, the passage of the side lever (whether on one side or the other,) on the inclined plane set to the required bevel, will shift the index hand and indicate the true bevel, to enable the operator to turn the log to correspond, as set forth."

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24. For *Improvements in Machinery for Making Casks;* James Hamilton, City of New York, April 13.

Claim.—"Having thus specified the various parts of my invention, and the manner of constructing and using the same, what I claim as my invention is as follows, viz: The sawing of two staves from one block, by means of two saws, which in succession enter the same kerf, then, in succession, diverge in opposite directions, and finally converge and pass out of the same kerf, substantially as specified, the two saws being mounted substantially as specified, so that they can be moved laterally in opposite directions, in combination with the templates or their equivalents, for giving the required lateral motions to the saws, as the block of wood is moved forward towards the saws, substantially as specified; in the machinery for boring holes for dowel pins, I claim the arrangement of the mandrels carrying the bits on separate slides, to admit of varying their distance apart, substantially as specified, in combination with the reversible fence or gauge, hung to a rock-shaft, mounted on a slide between the mandrels, and provided with the means of adjustment, substantially as specified, by means of which the bits can be set at pleasure, to bore the holes at any desired distance apart, and on the two edges, to correspond, the distance being gauged from the same end, with the view to economize timber, as specified.

"In the machinery for jointing staves, I claim, in combination with the circular saw, and the hinged carriage, which is governed by guides, to determine the form to be given, as described, the employment of the gauging apparatus to determine the quantity of stuff to be cut off and the gauge piece with its two points, and made adjustable on the carriage, substantially as specified, by means of which combination, the quantity of stuff to be cut away from each edge, is regulated to prevent waste, and an equal width of the two ends secured, when cutting the second edge, as set forth.

"In the machine for setting up the staves and driving on the hoops, I claim the spring arms jointed to the weight or head on the sliding shaft, or the equivalents thereof, the said arms being formed with lips inside to support the hoop whilst setting up the staves, as specified, when the said arms are combined with the cam plate, or the equivalent thereof, for the purpose of liberating the arms from the hoop, that they may be employed for driving on the hoop, substantially as specified.

"And, finally, in the machinery for turning the heads, I claim, in combination with the face chuck for receiving the head, and the clamping piece for clamping it against the chuck, substantially as specified, or the equivalents thereof, the employment of the jaws, operated by screws, or their equivalents, for the purpose of forcing together the different pieces constituting the head, preparatory to clamping them on the chuck and turning the head, subtially as and for the purpose specified."

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25. For *Improvements in Looms for Weaving Figured Fabrics;* Barton H. Jenks, Bridesburgh, and Robert Burns Goodyer, Philadelphia, Assignors to Barton H. Jenks, Bridesburgh, Pennsylvania, April 13.

Claim.—"What we claim as our invention is, 1st, The method of moving both picker sticks of a loom simultaneously and at each beat of the lay by the mechanism herein described, or the equivalent thereof, whereby a shuttle may be thrown from either side of the web, at each beat of the lay, and the momentum of the picker motion at one side of the loom is counterbalanced by that of the other picker motion at the opposite side of the

loom, the mechanism operating in such manner, that both the pickers are free to retreat to the outer ends of the shuttle boxes, the instant the shuttle is thrown, substantially as specified.

"2d, The combination of the pattern wheel U, arm W, doubled armed lever R, cross-head M, and stop L, operating substantially as herein set forth, to effect the shifting of the shuttle boxes, as herein set forth.

"3d, The combination of the forked marches, reciprocating levers, pattern drum and evening pin, substantially as herein set forth, to effect the working of the heddles from the shed, as herein set forth.

"4th, The combination of the supplementary arms on the cam shaft and pins upon the star wheel, or the equivalent thereof, operating substantially as herein set forth, to vary the number of changes of which the heddle mechanism is susceptible.

"5th, The combination of a fork and grid motion for effecting the stopping of the loom, when the weft thread breaks, as the shuttle is moving towards one side of the loom with the shifting plate lever, operating substantially as described, for preventing the loom from being stopped by the fork and grid motion, when the shuttle is thrown towards the side of the loom further therefrom.

"6th, The combination of the long rock shaft on the lay, with its arms, toes and levers, and of the chain lever and chain, with the breast beam lever, or the equivalents thereof, operating substantially as described, to effect the stopping of the loom when the shuttle is not in its proper shuttle box, at the time the lay is beating up, and also whenever the shuttle has not been ejected from its box, at the time the lay is completing its back stroke, as herein set forth."

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26. For *Improvements in Reeling Machines;* Elias & Simeon Macy, Laurel, Indiana, April 13.

Claim.—"We do not claim to have invented a self-acting stop motion, to stop the machine when a given length of yarn has been wound upon the reel, this having already been applied to machines similar to ours; but what we do claim is, constructing and arranging the stop motion substantially as described, so that by adjusting it, the length of yarn wound upon the reel before it is stopped may be regulated at pleasure, and all the skeins wound under the same adjustment will have the same length."

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27. For *Improvements in Sewing Machines;* Isaac M. Singer, City of New York, April 13.

Claim.—"Having thus fully described my additional improvements, what I claim therein as new is, 1st, the cut-off friction pad, constructed and operating substantially in the manner and for the purpose set forth.

"I also claim the construction and arrangement of the feeding apparatus, as above described."

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28. For an *Improvement in Seed Planters;* B. T. Stowell and A. Marcellus, Waddam's Grove, Illinois, April 13.

Claim.—"What we claim as our invention is, 1st, the application of the dibbles, &c., constructed and arranged as described, to the peripheries of the wheel, and operating in the manner herein set forth.

"We also claim the peculiar arrangement for feeding the seed to the hills, consisting substantially of the pistons and tubes, regulated by the coiled springs and bars, and operating as herein set forth."

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29. For an *Improvement in an Instrument for Opening Boxes;* George C. Taft, Worcester, Massachusetts, April 13.

Claim.—"What I claim as my invention in the above described instrument for opening boxes is, the tapering score, I, cut in both jaws, but smaller in the upper one, or F, so constructed that when both jaws are driven in between the side and lid of a box, the points of the jaws pass on each side of the nail, which will be griped in the score, I, so that as the jaw, F, is raised to take up the lid, it will draw the nail out of the side, and thus prevent the head of the nail from being drawn through the lid as it rises, while the jaw, G, rests upon the side of the box, substantially as described.

"2d, Is the tapering score, I, in combination with the peculiar construction and arrangement of the jaws, F and G, the latter being furnished with a recess at H, into which the former closes, in the manner and for the purposes herein set forth."

30. For an *Improvement in Seed Planters;* Francis Vandoren, Adrian, Michigan, April 13.

Claim.—"Having thus fully described my improved seeding apparatus and cultivator, what I claim therein as new is, the hollow reversing tooth, constructed in the manner and for the purpose set forth."

31. For an *Improved Oblique Bucket Paddle Wheel;* George S. Weeks, Oswego, New York, April 13.

Claim.—"I do not claim placing the paddles in oblique positions to the axis of the wheel, as this has been done before; nor do I claim two sets of paddles inclining obliquely in opposite directions, and all at the same distance from the centre of the wheel: but what I do claim as my invention is, the arrangement of two series of adversely inclining oblique paddles, one within the other, in the construction of steamboat wheels, substantially as herein set forth."

32. For an *Improvement in the Feed Apparatus of Planing Machines;* Joel Whitney, Winchester, Massachusetts, April 13.

Claim.—"I do not claim gearing the feed rollers with each other, by means of pairs of movable pinions connected to each other and to the feed rollers by links, this having already been done, for the purpose of giving large play to said feed rollers: but having described my improvements, what I claim as my invention is, the arrangement by which the upper feed roll is allowed to yield to any inequalities in the board, and at the same time draw down upon the surface, to which it has yielded, in proportion to the resistance to the cutting tools, that is, connecting the fixed shaft with the vertical sliding bearings of the upper feed roll, by means of the swinging inclined and vertical arms, the gears on the fixed shaft operating the lower feed roll, and also playing into the gears which move the upper feed roll; said latter gears having their bearings in the intersection or joint of the said arms, the arrangement being substantially as herein above set forth."

33. For *Improvements in Submarine Augers;* Norman Blake, Ira, New York, April 20.

Claim.—"Having thus described my invention, what I claim is, forming a pod auger with a hinge joint, E, in combination with connecting wires, substantially in the manner and for the purposes set forth and shown."

34. For an *Improvement in Mattrasses;* Thomas G. Clinton, Cincinnati, Ohio, April 20.

Claim.—"Having thus complied with the Patent Laws of the United States, in the matter of my discovery, treated at length in the specification of description in the drawings annexed thereto, and made part of the same, what I claim is, the use of the hair of hides of cattle, treated after the manner of, or steeped with the hides of cattle in the limevats of a tan-yard or other suitable place, as described, with or without other animal or vegetable matter, treated or not treated conjointly therewith, or separately, in the same way; and the use of other animal or vegetable matter, under like treatment and circumstances as described, whether used conglomerately, conjointly, or separately, or their equivalents, when such animal or vegetable matter is of the kinds used for upholstering or sleeping purposes, in the articles of mattrasses, ottomans, cushions, sleeping sofas, sacking bottoms, or analogous articles, whereby a new result is attained, viz: an article obnoxious to bed-bugs, without the necessity of any temporary application of poisonous mixtures thereto; thus furnishing the world with a harmless antidote to a great nuisance, and abolishing the necessity for a great peril to human life in the domestic circle."

35. For an *Improvement in Winnowers;* Thomas J. Doyle, Winchester, Virginia, April 20.

Claim.—"What I claim as my invention and improvements are, 1st, in combination

with the side openings, discharge outlets, or passages, *o o*, diagram, E, the invention, use, and application of the sliding diaphragm, with double sloping bottom, *p p p*, in diagram, E. This diaphragm bottom, as shown and used, has a double slope, or is a double inclined plane outward, inclining from each side of its elevated longitudinal centre.

"2d, I claim the use, application, and arrangement of an adjustable or sliding cheat or smut board, as shown in diagrams, C and F, and the same also in combination with the top screen, No. 1, with side apertures or outlets, *o o*, as shown in diagram, E, for the purpose as herein before fully specified."

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36. For a *Sash Stopper and Fastener;* Charles C. Felton, Dedham, Massachusetts, April 20.

Claim.—"I do not claim the combination of a rocking or vibrating friction plate, a lever spring, and notched plate, as they are arranged in the drawings of the patent granted to B. S. Hadaway; but as I dispense entirely with a lever separate from the rocking friction plate, and make the said plate to operate itself, I claim my improvement of combining the rocking plate, F, and lever, in one single piece, and extending it below the part which rocks on the part, *b*, of the notch of the catch plate, all essentially in manner as described, whereby I greatly simplify the construction of the window catch, and thereby render it not only cheaper in construction, but less liable to get out of order."

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37. For an *Improvement in Protecting Wheels and Axles of Cars, by Incasing them;* A. L. Finch, New Britain, Connecticut, April 20.

"The nature of my invention consists in the employment of metallic cylindrical tubes and casings, in which the axles and wheels of railroad cars are incased and secured, and also allowed to turn freely. The object effected by this invention is, the prevention of the very serious consequences which ensue from the accidents so often occurring on railroads, occasioned by the breaking of the wheels and axles of rail cars."

Claim.—"Having thus fully described the nature and application of my invention, what I claim as new is, incasing the axles and wheels of rail cars within a metallic casing, substantially as and for the purposes herein specified."

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38. For an *Improvement in the Keys of Piano Fortes, Organs, &c.;* William F. Furgang, Albany, New York, April 20.

Claim.—"I claim the improvement of the finger keys of organs, piano fortes, or any other musical instrument played in a similar manner, by constructing a part of every key in such a manner, that when in position on the key board, such part of every key shall be both level and in range with the similar parts of the other keys, so that the running of a finger over the keys of the whole chromatic scale on the key board, may be capable of producing similar effects to those that can now be produced by a similar running of a finger over the lower range of keys of piano fortes as now constructed, substantially in manner and form as set forth in the above specifiation."

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39. For an *Improved Capping of Screws;* Charles T. Grilley, New Haven, Connecticut, April 20.

"My improvement consists in the combination of a brass, copper, or plated cap, with an iron-wood screw, to the head of which it is attached as hereinafter described, in such manner as to unite with the strength and comparative cheapness of an iron screw, an external appearance and beauty, when inserted, similar and in all respects equal to that of screws made wholly of brass, copper, or plated metal."

Claim.—"I do not claim as my invention the adaptation simply of a cap of sheet metal to the particular configuration of any regular or irregular form, by compression, or in whatever other manner the same may be produced; but what I do claim as my invention is, the attachment of a brass, copper, or other suitable metallic cap, to and in combination with an iron-wood screw, substantially in the manner and by the process described in the foregoing specification, (which I conceive to be the only practicable method in which the same can be usefully effected,) whereby, and by means of the successive operations of punching or stamping, the nick is first cut through the shell, and then, after being adjusted to the groove or slot in the head of the screw, the sides thereof are driven down into and made

to press closely against the sides of the slot, leaving the bottom of the groove or slot uncovered, so that the cap, when closed round the head of the screw, will preserve its hold, without liability to be turned or displaced by the screw-driver, which works upon the iron surface at the bottom of the slot, and against the covered sides thereof; thereby furnishing to the public, at a comparatively small cost, a wood screw, having all the beauty and finish of a brass, copper, or plated screw, in combination with the greatly superior strength of an iron one. The invention is equally applicable to steel screws, which may be capped in a similar way."

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40. For an *Improvement in Machines for Drawing Spikes;* Daniel Hale, Hinsdale, New York, April 20.

Claim.—"Having thus explained and described my invention, what I claim is, the shackle, with the arrangement for clasping the head of a spike, for the purpose of drawing it from the cross-tie of a railroad track, in combination with the clevy and the lever, substantially as herein before described and set forth."

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41. For an *Improvement in Apparatus for Raising Water;* N. H. Lebby, Charleston, South Carolina, April 20.

"The nature of my invention consists in constructing the turbine with ribs on the outer face of its upper disk, which ribs, working under a cover to the wheel, cause, by the centrifugal effect produced while in motion, a void to be formed at or about the centre, the tendency of which will be to relieve the wheel of its weight, and consequently reduce the running friction."

Claim.—"What I claim as my invention is, constructing the wheel or turbine with exterior ribs, of any suitable number, size, or shape; the said ribs operating in combination with a cover or its equivalent, in the manner and for the purposes substantially as set forth."

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42. For an *Improvement in Refrigerators;* Andrew Maish, Cincinnati, Ohio, April 20.

Claim.—"I am aware that ice safes have been made with hollow shelves for water, but these are practically objectionable, on account of their costliness, cumbersomeness, difficulty of cleaning, and liability to twisting, either from the congelation of the water, in the event of the discharge becoming choked, or from the hydrostatic pressure: but what I claim therein as new is, the application, as herein described, to an ice safe or refrigerator, of a crimped, convoluted, or corrugated form, to the shelves, in order (in addition to combining strength with lightness of construction) to capacitate them for the collection, retention, and discharge of the water, which results both from the ice and from the atmospheric moisture within the case."

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43. For an *Improvement in Brick Machines;* Jesse Samuels, Allentown, Pennsylvania, April 20.

"My invention consists, 1st, in an improved feeding arrangement, by which the desired quantity of clay to fill the moulds can be regulated to a nicety, in connexion with a plunger, which partially condenses the clay into the moulds preparatory to pressing.

"2d, In the novel device or arrangement for clamping, removing the brick from the moulds, and placing them on a platform or apron, which I denominate a carrier."

Claim.—"Having thus fully described my invention and the manner of constructing the same, what I claim therein as new is, the manner of feeding the clay to the moulds, by means of the cut-off, in the hopper case, with the scraper, for heaping the clay under the plunger, in connexion with the plunger, operated as described, for partially condensing the clay into the moulds preparatory to pressing, substantially as described.

"I also claim the carrier, for clamping and removing the brick from the moulds, consisting of the clamp, and back plate, for clamping the brick, and the spring, and tumbler shaft and trigger, or their equivalents, arranged substantially as described, and operated upon by three stationary pins, substantially in the manner and for the purpose herein fully set forth."

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44. For an *Improvement in Rotary Pumps;* Henry C. Spalding and Gage Stickney, Hartford, Connecticut, April 20.

Claim.—"Having thus described the nature and operation of our invention, what we

claim as new is, the spiral flanch, working within a circular case, said flanch being constructed as described, in combination with the sliding valve, the spiral flanch and valve, operating in the manner and for the purpose substantially as herein shown and specified."

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45. For an *Improvement in Balance Gates;* William C. Van Hoesen, Leeds, New York, April 20.

Claim.—"Having thus described the nature and operation of my invention, what I claim as new is, the method of opening and closing the gate, substantially as herein shown and described, viz: by means of the ropes or cords passing over the semi or half pulley, and attached to the small upright, said pulley being attached to one of the side pieces, the gate being hung upon pivots, and balanced by the weight or counterpoise, the several parts being operated as set forth."

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46. For an *Improvement in Tailors' Measures;* William T. Wells, Shelbyville, Tennessee, April 20.

Claim.—"What I claim as my invention is, the graduated straps, No. 1, No. 2, and No. 3, in connexion with the several centres about which they respectively turn, and with the graduated arcs, the said centres being arranged substantially as herein set forth, and for the purposes specified, using for that purpose the aforesaid instrument, or any other substantially the same, and which will produce the intended effect; but I disclaim having invented the tape measure or the elastic square, designated as No. 3, underneath the main instrument."

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47. For an *Improvement in Hame Tugs;* R. B. Whipple, Cleveland, Ohio, April 20.

Claim.—"What I claim as my improvement is, the formation of the hame tug, by means of the two metallic plates, fitted together so as to embrace the buckle, loop, and cleft, substantially in the manner herein set forth."

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48. For an *Improved Reflecting Spirit Level and Square;* Francis Wilbar, Roxbury, Massachusetts, April 20.

Claim.—"I would remark, however, that I deem the cubical block, with its two mirrors and two spirit levels, arranged as seen in the drawings, the most convenient form; and it is this instrument, or combination of block or frame, two mirrors, and two spirit levels, or what is equivalent to the two levels, viz: a spherical surface level, I claim as my invention."

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49. For *Improved Devices for Casting Circle Plates, Roses, &c., with Dovetailed Grooves;* Nathan Matthews, Assignor to Richard Edwards, David A. Morris, and Nathan Matthews, Pittsburg, Pennsylvania, April 20.

Claim.—"What I claim as my invention is, forming the dovetails in circle plates by dovetail pieces, which are withdrawn lengthwise from the recesses, the said withdrawing being performed by attaching the dovetail pieces to levers, F F, within the cylinder, E, or body of the mould, the said levers being moved by a rod passing through the side of the cylinder or body of the mould, substantially as herein set forth."

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50. For an *Improvement in Railroad Car Brakes;* Benjamin Kraft, Reading, Pennsylvania, April 20.

Claim.—"I do not claim the mere application of friction rollers, *c c*, as such are not new; nor yet do I claim, independent of the means and manner shown, the employment of a stop, to prevent the advance rubber from being raised by the wheel, or exclusively of itself, the adoption of a spring to reduce the shock. But what I do claim as my invention is, the combination and arrangement of the sliding bar, E, made as described and represented in fig. 1, with the rollers, *e f*, and suspended frame. B, attached to a hanger, C, by a centre pin, *i*, on which is adjusted the spiral spring, *d*, said frame being made, arranged, and operated in the manner and for the purpose herein set forth."

51. For *Improved Valves for Steam Engines;* Matthias W. Baldwin, Philadelphia, Pennsylvania, April 27.

"My invention and improvement consist in arranging in a suitable valve chest, a duplex valve, (one part of which is actuated by valve gear in the usual manner,) and its office is to admit steam directly from the boiler, to actuate the other part, which opens and closes the passages, for steam to pass into or out of the cylinder."

Claim.—"What I claim as my invention is, the arrangement in the valve chest of a steam engine of a duplex valve, one part of which is actuated in the usual manner, by valve gear, to admit steam from the boiler to act directly on the other part, and force it to open and close the steam or exhaust passages, substantially as herein described."

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52. For an *Improvement in File Cutting Machinery;* John Cust Blair, Pittsburg, Pennsylvania, April 27.

Claim.—"Having thus fully described my invention for cutting files, I would state, that I do not claim a pattern for regulating the depth of the cut of the chisels; but I do claim the combination of the pattern, located between the cam and the chisel carriage, in the manner herein described, with said cam and carriage, and the file carriage, by which the pattern is moved; the whole arranged and operating substantially in manner and for the purpose set forth."

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53. For an *Improvement in Shuttles for Weaving Hair Cloth, &c.;* Daniel L. Dewey, Hartford, Connecticut, April 27.

Claim.—"What I claim as my invention is, the combination of the sliding bar with the springs, when used in connexion with stops attached to the shuttle boxes, or other convenient fixtures, so that the motion of the shuttle will slide the bar in such a manner, that when one of the springs drops one piece of the woof or filling, the other spring will receive and confine another at the other end, so that the pieces may be carried through alternately from each side, and released or dropped in the right position to be beat up, when the whole is constructed, arranged, and combined, substantially as herein described."

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54. For an *Improvement in a Hold-Back for Sleds;* Perry Dickson, Blooming Valley, Pennsylvania, April 27.

Claim.—"I do not claim connecting the dogs with and operating them by the backward pressure of the tongue; but I claim as my invention, as being more simple than the ordinary means by which this is effected, attaching the dogs to the roller rigidly, instead of to the runners as is usual, and connecting the tongue to the said roller by hinges or analogous joints, in such a manner that the backward motion of the tongue, in relation to the body of the sled, turns the roller on its axis, and forces the points of the dogs, so attached to it, into the snow or ice of the road, substantially as and for the purpose herein set forth."

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55. For an *Improvement in Smut Machines;* John M. Earls, Troy, New York, April 27.

Claim.—"Thus having fully described my machine, I wish it to be understood that I do not claim as new a "perforated case," the same having been heretofore in use; neither do I claim a spike rubber; nor a ventilator with spiral arms; nor scourers made of sheet or other metal; nor do I claim the oil box at the top of the machine, nor the oil pipe for the lower bearing of the shaft. But what I do claim as new is, 1st, The projecting screen chambers, in combination with the arrangements for separating the rubbing chamber from the fan chamber, whereby the grain is prevented from being affected by the blast from the fan chamber while it is passing through the rubbing chamber, and is only brought in contact with the current of air where it ascends to take away the chaff and other impurities, substantially as herein set forth.

"2d, I also claim, in combination with the scouring surfaces, the beating forks, for the purpose of beating the grain and breaking the hulls, while falling from the rubber to the scourers, whereby the berries are more effectually cleaned from adhering impurities, as herein set forth."

56. For an *Improvement in the Relief-Steering Apparatus;* Nathaniel T. Edson, New Orleans, Louisiana, April 27.

Claim.—"Having thus described the nature of my invention, the way in which it is constructed, and its operation, I do not claim any particular part of the apparatus as new; but what I claim as my invention is, the combination of the forked and unforked pawls with a single ratchet, and with rubbers placed face to face, and on the same side of the wheel.

"2d, I claim the combination of the spring, the arms, and the cap piece, with the relieving springs, whereby the pawls are supported with sufficient firmness, but at the same time permitted to have sufficient play to admit of the action of the said relieving springs, all as substantially set forth, represented, and described."

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57. For an *Improvement in Railroad Switches;* John F. Klein, Trenton, New Jersey, April 27.

Claim.—"What I claim as my invention is, the bars or shifters, constructed, arranged, and connected to the switches of a railroad, in the manner and for the purpose substantially as described, so that if the train run in either direction, and the rudder be placed in either position, as described, and if the switch or switches are not in a proper position, the rudder will act upon the shifters and move them gradually as the train approaches, so as to move and place the switches in such a position that the train may pass on unimpeded, without the risk of running off the track."

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58. For an *Improvement in Gins for Long Staples of Cotton;* Calvin Willey, Jr., Chicago, (now deceased,) Assignor to himself and Urial Walker, Babcock's Grove, Illinois, April 27.

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, regulating the feed of a cotton gin for ginning Sea Island cotton, by means of an endless apron, which may be set to or from the feed rollers, to suit the quality of the staple, and the quantity to be fed in to be cleaned, and still be driven by the same mechanical movement, substantially as herein described.

"I also claim, in combination with the covered feed rollers which receive the material from the apron and carry it into the machine, the series of alternate brushes and elastic beaters on the same shaft, for combing out the fibre and knocking off the seed, whilst it is still held by said rollers, as herein substantially set forth and described.

"I also claim, in combination with the inclined chamber, through which the material is driven by the blast from the wings of the beaters, the inclined chamber having a cross blast through it from the fan blower, to complete the entire separation of the fibre and the seed, both chambers being provided with screens, substantially in the manner and for the purpose herein fully set forth and described."

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59. For an *Improvement in Warm Air Furnaces;* Alexander Kelsey, Assignor to James Cowles, Rochester, New York, April 27.

"The nature of my invention consists in the employment of an equalizing flanch, so arranged that the air which enters the furnace on both sides of a radiating cylinder is warmed to about the same temperature, before entering the warm air conducting flues."

Claim.—"Having thus described the nature of my invention, and the manner in which it is constructed, what I claim as new is, the use of an equalizing flanch, with the tubes attached, by which the air on each side of the radiating cylinder is warmed to about the same temperature before entering the warm air conducting flues."

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60. For an *Improvement in Machines for Pressing Tobacco;* Ephraim Parker, Rock Island, Illinois, Assignor to Alfred A. Parker, St. Louis, Missouri, April 27.

Claim.—"Having thus fully described the nature, construction, and operation of my improved tobacco press, what I claim therein as new is, the use of the revolving mould disk, combined with its revolving bed plate, with the scraper, and cloth roller, or their equivalents, for keeping the moulds free from the liquorice or juice of the tobacco, substantially as described.

"I also claim the use of revolving sinkers, constructed substantially as described, combined with the pan and cushion, or their equivalents, for keeping the same clean, and the

combination therewith of mechanism for moving the sinkers a quarter of a revolution at every eight, more or less, number of pressings, substantially as described.

"I also claim the conductor, formed of endless aprons or belts, or their equivalents, for confining and retaining the plugs under pressure, until they are thoroughly consolidated, in manner and for the purpose substantially set forth."

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61. For a *Stud Brace for Flues of Sheet Water Space Boilers;* Andrew Lamb and William A. Summers, County of Hants, England, April 27; patented in England, December 9, 1848.

Claim.—"What we claim as our invention is, the stud brace, for bracing the flat surfaces of steam boilers, substantially as described in the foregoing."

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62. For an *Improvement in Brushes;* Freeman Murrow, Williamsburgh, New York, April 27.

"Brushes constructed in the usual manner, with fixed and immovable handles, are inconvenient for many purposes for which they are needed; to remedy these defects, and to facilitate execution in the use of brushes, is the object of my invention; and it consists in so connecting the handle with the brush thereof, by means of a ball and socket, and sliding joints, that the brush can be adjusted to any desired position and angle with its handle."

Claim.—"Having thus fully described my invention for brushes for white-washing, varnishing, painting, washing painted cornice and walls, &c., &c., what I claim as my invention is, the double adjustability of the brush, by means of the combination of the ball and socket joint, and the sliding joint, or their equivalents, substantially as herein set forth."

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63. For an *Improved Float Gauge Feed Regulator, &c., for Steam Boilers, &c.;* Thomas J. Sloan, City of New York, April 27.

Claim.—"I do not wish to be understood limiting myself to the construction and arrangement of parts herein above described, as these may be varied, without changing the principle or mode of operation of my invention.

"I am aware that a float placed within a boiler, or within a vessel communicating with a boiler, has been employed to regulate the position of ratchet hands, operated by an independent mechanism, to open and close a valve cock, or regulate the motion of a pump, the said float being employed simply to engage or disengage the said ratchet hands; but when so employed, the said float has been so arranged as to act on the said mechanism outside the boiler, &c., and hence, subjected to the difficulties above pointed out.

"I do not therefore claim, broadly, the employment of a float to regulate the action of an independent mechanism, as a means of indicating the height of water, and regulating the supply thereof, when such float acts upon such mechanism outside of the boiler; but what I do claim as my invention is, the employment, substantially as described, of an independent float, within a steam or other boiler or vessel, which, as its position is varied by the change of level of the water, shall act as a check or stop to the motion of a mechanism combined therewith, and operated by an independent motive force outside of and passing through to the inside of the boiler, substantially as described, to determine the supply of water to be given, or to give the required indication or alarm, as specified.

"And I also claim the method herein described, of preventing the action of the mechanism outside, which is actuated by an independent force, from reacting on and changing the position of the float, that it (the float) may be free to follow the varying level of the water, as specified."

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64. For an *Improvement in a Self-Loading and Dumping Cart;* B. T. Stowell, Waddam's Grove, Illinois, April 27.

Claim.—"What I claim as my invention is, the manner of opening and closing the slatted bottom of the cart body, substantially as herein set forth, viz: by means of a bar, which is jointed to the rear edge of the foremost slat, and which, when its rear end is unfastened, descends vertically, and allows the whole series of slats to be opened simultaneously, by the action of the weight within the cart body pressing upon the same; and when the rear end of the said bar is drawn rearwards and upwards, simultaneously actuates the whole series of slats, and thereby closes the bottom of the cart body."

65. For an *Improved Steering Apparatus;* Alfred Swingle and Nehemiah Hunt, Boston, Massachusetts, April 27.

Claim.—"We are aware that the steering gear and rudder head have been connected together, and the tiller made to rise and fall with them; and therefore we do not claim such an arrangement: but what we do claim as our invention is, the construction and arrangement of the tiller and rudder head as described, in combination with steering gear, entirely separate from the rudder head; the tiller being connected with the latter and attached to the former in such manner, that when the rudder is unshipped, or raised unusually high, by striking the bottom, the tiller will be disconnected therefrom, without danger of breaking either the steering gear or the rudder head, or being itself broken."

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66. For an *Improvement in Boxes for Journals;* Henry Turner, Charlestown, New Hampshire, April 27.

Claim.—"I claim making the cap box in the manner described, that is to say, of alternate pieces of hard and soft metal, arranged in a helical position, by which, together with the circular end pieces, the soft metal is kept in place, and friction and injury to the axle prevented, substantially as described."

RE-ISSUES FOR APRIL, 1852.

1. For an *Improvement in the Construction of Furnaces for Smelting Iron Ore;* J. Augustus Roth, Philadelphia, Pennsylvania; patented October 31, 1839; re-issued April 6, 1852.

Claim.—"Having described the construction and operation of my improved furnace for smelting ores and metals, I will now state what I claim as my invention and improvement. 1st, I do not claim the increasing of the draft as separately by itself. 2d, And I do not claim to generate steam, or to heat the blast by waste heat, otherwise than hereafter claimed.

"I therefore only claim as my invention and improvement, the arrangement of the five chambers, opening each by a flue into one horizontal flue, in combination with the boiler placed in said flue for generating steam, and the pipes therein, as a means of heating the blast; the whole being constructed and operating as described."

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2. For an *Improvement in Washing Apparatus;* James T. King, Baltimore, Maryland; patented October 21, 1851; re-issued April 13, 1852.

Claim.—"Having thus fully described my invention, what I claim therein as new is, placing the rotary boiler for washing clothes immediately over the fire, and so combining with it a reservoir or top boiler, as that said rotary boiler shall form the lower half of the flue, whilst the said reservoir or boiler shall form the upper half of said flue, and from which the revolving boiler may be supplied with water, and thus greatly economize heat, substantially in the manner herein described and represented.

"I also claim, in combination with the rotary boiler and shielded stationary pipe, the top reservoir or boiler for receiving the excess of steam from the boiler, and heating the water therein; and this I claim, whether said reservoir is divided by partitions or not; the whole being arranged in the manner and for the purpose herein described."

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3. For an *Improvement in Self-Detaching Brakes;* John Lahaye, Reading, Pennsylvania; patented April 10, 1847; re-issued April 13, 1852.

Claim.—"What I claim as my invention, in combination with the method of forcing the brakes against the wheels, by connecting the brakes, or the mechanism which works them with the bumpers or draw-bars, substantially as specified, is, the method, substantially as specified, of releasing the brakes, notwithstanding the continuance of the forces by which they were applied, by the reversing action of the wheels on the brakes, to effect a disengagement of the pressing force, as described.

"As one of the devices for applying the principle of my invention, I also claim connecting, by means of a detachable catch or hook, substantially as specified, the bumper or draw-bar, with the lever, or its equivalent, which forces and holds the brake against the wheels, substantially as specified, so that, notwithstanding the continuance of the back-

ward pressure on the said bumper or draw-bar, the connexion can be readily broken, to relieve the brake, and thus leave the wheel free to run, as specified.

"And I also claim making that part of the brake which acts directly on the wheel, separate from, but so connected with, as to slide freely on the part which receives the action of the mechanism for forcing the brake against the wheel, substantially as described, by means of which, on reversing the motion of the wheel, the one part of the brake in contact therewith is made to slide, to give the required motion for effecting the disengagement, as above specified."

DESIGNS FOR APRIL, 1852.

1. For a *Design for Cooking Stoves,* Anthony J. Gallagher and John J. Baker, Philadelphia, Pennsylvania, April 20; ante dated January 7, 1852.

Claim is to the application of the above design to cooking stoves.

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2. For a *Design for Cooking Stoves;* John J. Savage, Assignor to Alexander Morrison and Thomas M. Tibbitts, Troy, New York, April 13.

Claim is to the configuration of and ornamenting the plates and panels of cooking stoves, substantially the same as herein represented and set forth.

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3. For a *Design for a Cooking Stove;* Samuel H. Sailor, Assignor to North, Harrison & Chase, Philadelphia, Pennsylvania, April 27.

Claim is to the design and configuration of the conical rods, series of converging angular rays, central figure, and leg, as herein described, forming an ornamental design for a cooking stove.

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4. For a *Design for a Portable Furnace;* James G. Abbott and Archilus Lawrence, Philadelphia, Pennsylvania, April 27.

Claim is to the combination and arrangement of the ornaments herein represented and specified, making an ornamental design for a portable furnace.

MECHANICS, PHYSICS, AND CHEMISTRY.

Translated for the Journal of the Franklin Institute.

Summary of a Series of Meteorological Observations made on the Pyrenees, during the summers of 1848 *and* 1849; *on the Mountains of Provence, during the summer of* 1850; *and on the French Alps, during the summer of* 1851. *By* M. ROZET.

The aqueous vapors which emanate continually from the surface of the earth, rise in the atmosphere, without being visible, at least generally, to a height proportional to the temperature of each place. As the temperature falls in proportion as the height increases, these vapors finally come into a region where they are compelled to pass from the invisible to the visible condition. When the air is calm and the heavens serene, this region is marked by a light haze, like a gauze, terminated above by a horizontal surface. The observer sees this terminal surface perfectly when he stands at the same elevation with it, or a little above or below it. When he is at a certain height above it, he sees it forming around the horizon a narrow band constituting an immense ring, of which he occupies the centre.

It is on the level of this terminal surface of the ocean of vapors that the cumulus clouds generally originate. Limited by it below, they rise

above it to variable heights in mammillary masses, and terminate above in irregular curved surfaces. When these clouds do not touch each other, the interstices which separate them are seen at the level of their bases, occupied by a light fog which connects them together.

The height of the terminal surface of the ocean of vapors varies with the temperature; being at its minimum about sunrise, it attains its maximum about 2 o'clock afternoon, then sinks again until the next morning. The summits covered with snow determining around them a region colder than the zone of the atmosphere which is at their level, the portion of the terminal surface of the vapors which passes above them bends towards them, as the clouds on this surface come and attach themselves to the mountain. At the level of this surface I have always found the temperature above 0°. (32° Fahr.) In the Pyrenees, the maximum of altitude was 2200 metres, in the Alps I have known it to attain 3200 metres.

In the valleys, peculiar circumstances, such as the presence of snow, winds from the north sweeping their flanks, shadows thrown by high crests, &c., determine cold regions, in which the vapors coming from the soil are forced to pass into the visible state far below the level at which this happens for the country in general. Then there is seen to form in these regions a horizontal mist covering the valleys, and often afterwards strata of cumulus lower than the general mass, which at the same moment is higher than the summits of the mountains overlooking the flanks of the valleys.

In the Alps, the height of the upper surface of the cumulus often exceeds 4000 metres, (4376 yards,) of which I have been able to assure myself by referring it to the summit of Pelvou, which rises to 4100 metres (4485·4 yards) above the level of the sea. It is above this surface, and often at more than 2000 metres (2188 yards) above it, according to my estimation, that the region of the *cirrus* begins. These clouds, which the observation of halos and the aerostatic ascent of MM. Barral and Bixio (*Journ. Frank. Inst.*, *Vol.* xxi. 3*d series*, *p.* 34) have shewn to be composed of very small crystals of ice, must, from the aspect of their lower surfaces, which are arranged like that of the cumulus on an immense spherical vault, occupy a region terminated below by a horizontal surface.

In calm weather, these two strata of clouds of different nature exist together without mingling. All the clouds of each stratum are in the same electric state; they are seen to approach, even to touch each other, without giving rise to the slightest electrical discharge. But the strata themselves are generally in opposite electrical states; for when, in bad weather, the clouds of each meet each other, the approach and contact are marked by greater or smaller electrical discharges.

It is from the mingling of the clouds of these two strata that storms, rain, and snow result. Then the cirrus is seen to descend, and the cumulus to rise, stretching itself out into columns, and the contact is immediately announced by the formation of a *nimbus*, in the vicinity and in the midst of which the electric discharges are seen when they take place. Often in summer, in autumn, and almost always in winter, the nimbus forms without the least appearance of electric discharges. This proves that the electricity which is developed during storms is one of their results and not the cause.

I have seen in the high mountains, heavy bodies of cumulus, hiding the sun from the country below them, exist above for several days together without giving rise to the slightest storm, nor to the least rain. I have made the same remark as to the strata of cirrus, with this difference, that this kind of clouds, which have but little thickness and rarely touch each other, allow a part of the sun's rays to pass.

When the cirrus and cumulus exist simultaneously, without touching each other, neither storm nor rain is produced; it is only at the points where the junction takes place that these phenomena shew themselves. This is the precise reason why it does not always rain at the same time at all points covered by a stratum of cumulus.

This year, in the Alps, I have frequently had occasion to establish the fact that it always snows in the region in which the meeting of the cirrus and cumulus takes place. The elevation of this snowy region varies with the temperature of the air, or, what amounts to the same thing, with the height of the stratum of cumulus. I have established this fact by observation on high points, whose elevation I had geodetically determined, on which snow fell while it rained on the plains and in the valleys below. Having at the same time observed the thermometer, I found that this summer, in the High Alps, whilst it rained in the valleys, at a height of 800 metres, (875·2 yards,) the thermometer being at—

+5°	Cent.,	it snowed	down	to	900 metres,	984·60 yards.
7	"	"	"		1000 "	1094·00 "
8–9	"	"	"		1200 "	1312·80 "
10	"	"	"		1500 "	1641·00 "
12	"	"	"		1700 "	1859·80 "
14	"	"	"		2000 "	2188·00 "
16	"	"	"		3000 "	3282·00 "

Having been three times so situated that I could easily pass from the region of snow to that of rain, I found that the rain in large drops came from flakes of snow, while the rain in small drops, which is generally colder than the other, comes from small grains of snow. In the snowy *nimbus clouds*, the thermometer stood at +2° (35·6° Fah.) in those giving flakes, and at +1° or +1·5° (33·8° or 34·7° Fah.) in those having the snow in small grains.

During three months I made a series of barometric observations, for the purpose of learning how the mercurial column varies at the approach of bad weather, during, and after it, which series led me to the following results:

The mercury begins to fall when cirrus and cumulus shew themselves in the atmosphere at the same time; the fall is greatest at the time of the formation of the nimbus. When the rain lasts only a few hours, the barometer remains stationary, and immediately afterwards rises sensibly, at the same time that the nimbus rises, passing into cumulus. When the rain has lasted several days together, I have seen the barometer fall and rise several times, without being able to connect its movements with those which were then going on in the clouds.

When in high regions the cirrus approach the cumulus, bringing with them a very low temperature, the thermometer falls suddenly several degrees, and the cold which results is very sensible, although in the place where the meeting takes place, I have never seen the thermometer descend below 0° (32° Fah.) This is the explanation of the sudden cold

which storms and rain bring with them. All my observations taken together, go to prove that all the aqueous meteors of the atmosphere have for causes, solely, variations of temperature, and that the development of electricity which often accompanies them, is simply a result of the approach and meeting of clouds of different kinds.

A great number of hypotheses have been formed to explain the formation of rain and storms. Hutton said, "The rain results from the mixture of two masses of air saturated with moisture, but of unequal temperatures." I have, while on a mountain, caused a mass of vapor, obtained by throwing snow on burning charcoal, to pass through a cumulus whose temperature was below 5°, (41·9° Fah.,) and no precipitation resulted. The artificial vapor soon disappeared by mixing itself with the other, whose temperature it did not sensibly increase. On railroads during fogs, I have often had opportunities of seeing that the steam coming from the chimney of the locomotive disappeared in the midst of the fog without giving rise to the slightest rain.

It is not possible, moreover, to account for the formation of the rain, and the principal phenomena which accompany it, by the rising of the clouds into a region where low temperature would precipitate the vapor; in the high regions of the atmosphere the vapor is in a frozen condition; when the temperature of the region in which the cumulus are situated lowers, they immediately descend, without any precipitation, to a point at which the temperature of the air is high enough to allow them to exist tranquilly. This fact may be established by a single day's observations on high mountains. During four years of observations on high mountains, I have never seen true rain form except by the mingling of cirrus with cumulus, that is, of frozen with vesicular vapor.

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*Hollow Bricks.**

"There is nothing new under the sun," was the observation of Solomon. If you remember, it was stated that it was intended by the Bey to send over specimens of hollow bricks, at the present time in constant requisition in Tunis, for the Great Exhibition; but the interest of such a contribution was at the last moment accidentally overlooked.

In the Museum of the Bath Scientific Institution, specimens of hollow bricks used by the Romans, and dug up within a short distance of the spot where they are now deposited, may be seen by any party interested. They are double the size of those used by Messrs. Bazely & Co., and are cemented together by *genuine Roman cement*. And, no doubt, a machine like our modern ones for making them was also used by the Romans. It would be interesting to test the strength of these bricks, and of the cement that unites them, as compared with the modern manufacture. In Bengal, the floors of Bungalows are usually constructed with earthenware pots, commonly called "Kedgeree pots," turned over, with their orifices on the ground. Charcoal is filled between the interstices, and a coat of brick concrete is laid on the top, thus forming a perfectly dry floor. What a comfort would floors of hollow brick prove to the kitchens or cellars in some of our damp localities! H. W.

* From the London Builder, No. 469.

Extracts from the Engineer's Report to the Trustees of the Philadelphia Gas Works, in their 17th Annual Report, January, 1852.

The manufacturing department exhibits a moderate increase in the quantity of gas produced, and has fully maintained its usual character for purity and illuminating value. The gas made in the year is two hundred millions, eight hundred and forty-two thousand cubic feet, which added to the previous production, make the whole quantity yielded by the Works, eleven hundred and ninety-eight millions, seven hundred and one thousand cubic feet. The consumption of the different Districts is as follows:

To the District of Spring Garden, 7,039,800 cubic feet; to Southwark, 5,279,000 cubic feet; to Moyamensing, 1,254,700 cubic feet; and to the City proper, 181,638,825 cubic feet; leaving as the amount used in the Works and lost by leakage, 5,629,675 cubic feet, or rather more than 2½ per cent. of the quantity made. This item has been somewhat increased this year by several incidents of unusual character. On two occasions mains in the street were broken by the caving of cellar vaults extending under the street, and the gas escaped in large quantity for several hours, before notice of the accident reached the Works. Another main was similarly fractured by the sinking of a culvert, and a considerable number of service pipes of the largest size was broken at the extensive fires in Chesnut street, at Sixth and Seventh streets, and continued to waste gas for several days before they could be reached through the burning ruins.

* * * * *

The varieties of coal used in any considerable quantity are those obtained from Pittsburg, Pa., Richmond, Va., English Newcastle, English Cannel, and a new article from New Brunswick, in British North America, which is used as a substitute for rosin when the coals are not rich enough in bitumen.

* * * * *

In accordance with the desire of the Committee on Police, the distribution has been so conducted as to place a pipe for the supply of public lamps in nearly every street, lane, and alley east of Schuylkill Third street; the few that remain unsupplied will be completed early in the spring, and a large proportion of those situated west of that line, will be similarly furnished in the course of this year.

The length of pipes thus laid is 42,141 lineal feet, chiefly of two, three, and four inch calibre, with a few six inch and eight inch, making with those previously laid, an aggregate length of 542,408 feet, or 102¾ miles.

The increase of services, meters, and burners within the City, is greater than in any previous year, nearly compensating for the withdrawal of the entire number in the District of Spring Garden, so that the number of lights supplied is but 1600 less than those in use a year ago, including those in that populous district.

The new meters and service pipes added are 1211, the whole number in use being 10,449.

The applications registered are 2529, removals and discontinuances

1339; the increase being 1190, with 21,616 additional lights, besides 124 new lamps in the streets.

The entire number of City customers on the books on the 31st of December, was 10,406, using 136,620 lights; the public lamps are 1588 in the streets, 50 in market houses, and 62 in public squares. The Districts of Southwark and Moyamensing report 4943 private and 178 public lights, making a total of 143,441 supplied by these Works.

* * * * *

The effect in economizing labor and materials is made very evident, by comparing the lime accounts of the last three years. Thus in 1849, 135,000,000 feet of gas required for purification 129,048 bushels of shell lime; in 1850, when the first series of enlarged purifiers was used, 182,000,000 feet were purified with 111,668 bushels, and in the past year, with two such enlarged series in operation, 200,000,000 feet have been purified with only 64,545 bushels. Should there be no very great increase of make of gas this year, it is probable that by the addition of the last and largest series, the quantity of lime may be reduced below 50,000 bushels.

Some experiments have also been made during the year, with a view to ascertain the value of several schemes for the manufacture and use of gas, that have recently claimed a share of public attention, both in this country and in Europe.

Among them are the so-called hydro-carbon gas, made from steam in combination with various hydro-carbonaceous materials, patented here and in England, by Mr. White; the gas from asphaltum or other highly bituminous substances recommended by Dr. Gessner; and the pure hydrogen light with platinum wick, put in operation by M. Gillard, in Paris. These schemes do not bear upon their face the evidence of absurdity or impracticability, such as attaches to the famous project of electric light at almost no cost, so much agitated a year or two back; but the results of our experiments are not such as to lead to the belief that any advantage would be derived, at present, by adopting them upon an extensive scale. The proper course with respect to them will be to keep them in view, by following up experimentally all their modifications and improvements, of which some that are of practical importance have already been suggested, so as to be prepared to substitute them for the present methods, as soon as such course may be rendered advantageous, either by the perfection of the new plans, or some commercial revolution affecting the value of the materials or products of the different processes of manufacture.

The only other experimental operations of the year of which mention need be made, were those connected with the ignition of the large body of Virginia coals already adverted to.

This ignition, which was undoubtedly of spontaneous origin, being for some time confined to the central and inaccessible parts of the mass, commenced early in the autumn, and spread very much through the interior of the heap before it became evident at the surface, by any other symptom than the peculiar benzoic odor that invariably accompanies this species of decomposition. As soon as the existence and locality of the ignition was discovered, attempts were made to check it, by the effusion of carbonic acid gas generated by the combustion of coke in an air-tight furnace, sup-

plied with air by means of a fan-blower. Large volumes of the gas were thrown upon the heap, and were also forced into the interior, through trunks and pipes of large calibre, the effect of which was to extinguish in a few moments every appearance of conflagration and active combustion, but it did not seem to influence materially the tendency to slow decomposition, by which great waste of the useful constituents of the coal is produced, and the fires rekindled on the withdrawal of the mephitic gas.

After repeated trials of this process, made through several weeks, it became evident that the entire destruction of the coals could be prevented only by their removal and speedy use, for which purpose the carbonic acid had to be discontinued, and the coals flooded with water.

Report on Analysis of Gas.

Philadelphia, January 6th, 1852.

John C. Cresson, Esq., Engineer, &c.

Sir:—We have the honor herewith to communicate the results of observations recently made by us at your request, upon the comparative illuminating powers of Gas used in New York and Philadelphia respectively.

The following table shows the observations actually made:

Date.	Denomination.	Pres're at Burner	Time.	Interval.	Meter Reading.	Quantity.	Cubic ft. per hour.	Mean cons'n pr hour.	Tests.	Photometric Distance.	
										Gas burner.	Candle.
1852.		in.	h. m.	m	d.			c. f.			in.
Jan. 3.	Manhattan Gas.	0·4	2·12		20·0				No. 1	37·125	10
			·19	7	44·0	24·0	3·429		2	37·5625	"
			·32	13	90·5	46·5	3·577	3·5020	3	37·375	"
Exp. I.	Fish-tail Burner.		·37	5	108·0	17·5	3·500		4	37·5625	"
									White	37·9375	"
									" F.	38·	"
									Mean	37·59·375	"
Jan. 3.	Manhattan Gas.	0·2–0·25	2·43		8·5				No. 1	45·125	"
	Argand Burner.		·49	6	40·0	31·5	5·250		2	45·	"
Exp. II.	With conical deflector and swelled glass chimney, 7·5 in. high.		·55	6	71·0	31·0	5·167	5·2080	3	44·875	"
									4	44·875	"
									White	44·625	"
									Mean	44·9	"
Jan. 5.	Philadelphia Gas.	0·4	11·18		25·9				No. 1	46·75	"
			·30	12	86·4	60·5	5·041-6		2	47·	"
Exp. III.	Fish-tail burner.		11·54		22·0			5·0375	3	46·625	"
			12·00	6	53·2	30·2	5·031-3		4	45·9375	"
									White	46·625	"
									Mean	46·5875	"
Jan. 6.	Philadelphia Gas.	0·225	0·11		18·5				No. 1	43·	"
			0·16	5	44·5	26·0	5·200		2	43·75	"
Exp. IV.	Argand Burner, as before.		·38		8·6			5·1600	3	42·875	"
			·43	5	33·6	25·6	5·120		4	42·75	"
									White	42·875	"
									Mean	43·05	"
Jan. 6.	Philadelphia Gas.	0·275	0·45		15·5				White	F. 47·625	"
	Argand Burner.		0·51	6	52·0	36·5		6·0830	"	A. 47·5	"
Exp. V.	Normal illumination.								Mean	47·5625	"

The observations in New York were made during day-time, but in a chamber utterly darkened; the tinting of whose walls and furniture was more favorable for experiment than was the case in Philadelphia.

The pressure-gauge was filled with Croton water in New York, and Schuylkill water in Philadelphia. As the absolute quantities consumed were otherwise directly ascertained, the record of the circumstance is of no further interest than as showing that the gases burned were of equal elasticities, respectively. The meter used was a small one, each of whose divisions corresponded with the $\frac{1}{50}$th of a cubic foot; the ratio of these divisions to minutes of time, is of course equivalent to that of cubic feet per hour, as given in the 8th and 9th columns. The readings of this in Philadelphia, were in fact made from minute to minute, at the beginning and end of each experiment, through the respective intervals. The grouping used in the table for convenience gives a mean result, very slightly differing (in the third decimal place) in excess from the average of the individual intervals.

The tests used were tissue papers of different colors as follows: Nos. 1 and 2 were different shades of red, or properly pink, No. 2 being the lighter; No. 3 was a light yellow or citron; No. 4 a sea green. The other was a white laid paper, of uniform texture and thickness.

The gas burners are indicated in the table. In New York, the pressure with the argand was all that could be obtained; the stop-cock being entirely open, and the burner doing its best. In Philadelphia, where a higher pressure was attainable, the stop-cock had to be more than one-third closed; and the burner was not giving its best flame. Therefore, the fifth experiment was made under circumstances differing as to pressure, but affording, as we consider, the properest practical comparison.

The candle was one of Judd's patent sperm. sixes. There was no opportunity for weighing the actual consumption of it in New York, and therefore it was not weighed in Philadelphia. The results, then, are still affected by a possible want of uniformity in this respect. Otherwise all pains were taken to keep its flame at a maximum state of illumination, with a wick of constant length, and with the same side turned always to the photometer.

This was of Ritchie's arrangement, where two glass mirrors, oppositely inclined at 45° to the horizon, reflect the light received at either end of the oblong chamber in which they lie, vertically upwards to a common orifice. We were reliably assured that the mirrors had been reversed, and no appreciable difference recognised between them. We did not, therefore, repeat the experiment by turning it end for end, but used it always in the same position, with the candle, as shown, at a constant distance from the apex of the mirrors; from which also the distance of the gas light was measured.

The numerical deductions from the observations are exhibited in the following table:

Actual Distances.		Ratio of Squares.						
Candle.	Gas Burner.	Candle	Number of Candles equal to 1 Gas light.	Consumption of Gas per hour.	Illuminative Power.	Ratio of Illumination.	Kinds of Gas and Burner.
in.	*in.*			*c. f.*			
10	37·59375	1 :	14·133 ÷	3·502 =	4·036	0·93	Exp. I. N. Y. Fish-tail.
10	44·9	1 :	20·160 ÷	5·208 =	3·871	0·89	" II. " Argand.
10	46·5875	1 :	21·704 ÷	5·0375 =	4·528	1·	" III. Phila. Fish-tail.
10	43·05	1 :	18·533 ÷	5·160 =	3·592	0·83	" IV. " Argand.
10	47·5625	1 :	22·622 ÷	6·083 =	3·719	0·86	" V. " do. No. 2.

These ratios of illuminative power may be combined in various ways for a conclusive result, according to whichever burner and state of pressure may be considered as the fairest practical index. If the fish-tail burner and the greatest density be so regarded, as we are inclined to do, then the Philadelphia gas is at least 7 per cent. more illuminative, with equal quantities in equal times, than the Manhattan.

The following statements show the other results, thus:

	Philad'a.		Manhattan, N. Y.
Fish-tail burner,	1·	:	0·93
Argand, equal pressure,	0·83	:	0·89
	0·83	:	0·8277 :: 1 : ·9972

or New York Manhattan gas $\frac{1}{4}$ per cent. worse than Philadelphia.

Again,

	Philad'a.		Manhattan, N. Y.
Fish-tail burner,	1·	:	0·93
Argand burner, best flame,	0·86	:	0·89
	1·	:	0·9625

i. e. New York Manhattan gas $3\frac{3}{4}$ per cent. worse than Philadelphia.

Finally,

	Philad'a.		Manhattan, N. Y.
Fish-tail burner,	1·	:	0·93
Argand, average,	0·845	:	0·89
	1·	:	0·9795

i. e. New York Manhattan gas 2 per cent. worse than Philadelphia.

The diversity of these results serves to show, what was otherwise to have been expected, that any and every illuminating gas, according to its chemical constitution and the pressure under which it is stored and delivered, requires a burner of a particular form and size to develope its fullest efficiency; in other words, that every gas wants its own burner.

In the present instance, the fish-tail burner used seems to leave very little to be desired for the Philadelphia gas; and the numerical results would undoubtedly have been different, had the New York gas been tried with its best adapted burner: but this would have required a series of

observations and trials which we were not authorized in making; and, besides, the fish-tail and the argand seem to us to embrace the two limiting modes of burning between which the maximum effect must be found.

In this aspect the last result, which covers to all probable variations of management or mismanagement in the ordinary use of gas, appears to us worthy of undoubted acceptation.

J. H. Alexander,
John F. Frazer.

Report on the Analytical Investigation of the Illuminating Gases of New York and Philadelphia.

The New York gas was taken from the office of Messrs. Spies, Christ & Co., corner of Broad and Beaver streets, in glass tubes drawn out to fine points, in which it was sealed by the blow-pipe flame, after a sufficient amount of the gas had passed through to insure the total expulsion of atmospheric air. The Philadelphia gas was taken at the Laboratory in College Avenue, Tenth street, between Market and Chesnut streets. The results prove them both to have been free of atmospheric air.

The course of analysis pursued was that of Prof. Bunsen, a description of which will be found in the *Journal of the Franklin Institute* for 1849. The results are given in volumes as the determinations were made, the reductions being in every case to the usual standards of England and the United States, viz: to 32° Fahr. and 30″ Barom. The thermometer was an accurate one of German manufacture. The barometer was a French aneroid, which had been previously compared with an ordinary mercurial barometer, and which would indicate the ·01 inch.

The following are the results of the analysis of 100 volumes of the two gases:

		New York Gas.	Philadelphia Gas.
Olefiant Gas	CH,	8·32	6·38
Marsh Gas	CH^2,	32·92	54·84
Hydrogen	H,	24·04	26·27
Carbonic Oxide	CO,	11·60	4·42
Carbonic Acid	CO^2,	2·10	0·97
Oxygen	O,	0·19	0·04
Nitrogen	N,	20·83	7·08
		100·00	100·00

James C. Booth,
Prof. App. Chem. Univ. Pa.

William L. Faber,
Pract Chem. & Metallurgist.

Philad., Dec. 30, 1851.

Analysis of Illuminating Gas, furnished for Consumption in New York and in Philadelphia, and Comparison of its probable Chemical Constitution in the two Cities respectively.

The sample of New York gas was collected at the New York Hotel in the forenoon of 2d January, 1852, by J. H. Alexander, and understood to be furnished there by the Manhattan Gas Company; the sample of Philadelphia gas is believed to have been gathered in the forenoon of 1st January, 1852, by Professor Booth, from a burner in his Laboratory.

Direct measurements, corrected for a uniform barometer-stand of 30 in. and constant temperature of 32° F., gave the following results:

		Manhattan Gas.	Philadelphia Gas.
Carbonic Acid	CO^2,	0·0222	0·0087
Hydro-Carbons,	CH^2,	0·0928	0·0996
Olefiant Gas	C^2H^2,	0·0344	0·0204
Lt. Carburetted Hydrogen	CH^2,	0·7089	0·3227
Hydrogen	H,		0·4049
Nitrogen	N,	0·1231	0·1461
		0·9814	1·0024

Assuming a constitution in accordance with the formulæ given above, these results may be reduced for comparison as follows:

	Manhattan.		Philadelphia.	
	Volume.	Weight.	Volume.	Weight.
CO^2,	0·0227	= 0·0777	0·0087	= 0·0306
CH,	0·0945	= 0·1044	0·0993	= 0·1129
C^2H^2,	0·0350	= 0·0774	0·0204	= 0·0464
CH^2,	0·3204	= 0·4035	0·3220	= 0·4172
H,	0·4020	= 0·0623	0·4039	= 0·0645
N,	0·1254	= 0·2747	0·1457	= 0·3284
	1·	1·	1·	1·
Corresponding spec. grav.,		0·444		0·432

The quantities inscribed as hydro-carbons were among the volumes absorbed by chlorine water in the dark; and no doubt appear slightly in excess from the vapor of naphtha accompanying the potassium used as one of the re-agents. The sample on hand was not sufficient to allow a repetition of the experiment by which this source of error might have been eliminated; but as both samples were purposely treated alike, it is fair to consider its influence as proportionate in the two cases, and as therefore not affecting the comparison here.

The smallness of the sample of Manhattan gas also gave no opportunity for separating the proportions of light carburetted hydrogen and pure hydrogen in that instance, as was done in the case of the Philadelphia gas. In the comparison, therefore, they are distinguished in the same ratio for the former as was found experimentally for the latter.

And the same obstacle prevented the experimental determination of specific gravities. The values given for this term above, are therefore only theoretical, and have been presented merely in illustration; though they may be presumed not to deviate materially from the fact.

Finally, if abstraction be made of the nitrogen and the carbonic acid, the former of which certainly and the latter probably contribute nothing to the illuminating power in combustion, the economical efficiency of the two samples may be compared in the ratio of their aggregated combustible elements, as under:

	Carbon.	Hydrogen.
Manhattan gas,	0·45845 = 1·	0·18915 = 1·
Philadelphia gas,	0·44944 = 0·98	0·19156 = 1·01

This last comparison shows the Manhattan gas to be richer in carbon by 2 per cent. and poorer in hydrogen by 1 per cent., under equal weights, than the Philadelphia gas; and implies besides, that under low pressures at the burner, the Manhattan gas should have the advantage in illuminating power, while under high pressures this advantage would be exhibited by the Philadelphia gas; and, finally, that within this range there is a point of pressure at which the illuminating power of the two gases, with the same burner, would be found exactly the same.

DAVID STEWART,
J. H. ALEXANDER.

Baltimore, February 16th, 1852.

NOTE.—A later analysis of the Philadelphia gas, made by Dr. CHARLES M. WETHERILL in the month of February, gives the following result:

Olefiant gas and Hydro-carbon vapors,	8·936
Oxygen,	0·136
Hydrogen,	44·168
Light Carburetted Hydrogen,	41·620
Carbonic Oxide,	5·081
Carbonic Acid,	0·000
Nitrogen,	0·059
	100·000

*Potash Salts in Soot from Blast Iron Furnaces.**

At the Glasgow Philosophical Society, on Wednesday, Dr. Penny communicated his discovery of the presence of a considerable quantity of potash salts in the soot from blast iron furnaces. The soot experimented upon was obtained from the Coltness Iron Works, where it collects in the flues that lead the heated gases, and other products of combustion, from the top of the furnaces to the air heaters and steam boilers. Dr. Penny gave the particulars of a careful analysis of the soot, and exhibited specimens of the potash salt, which had been extracted in large quantities by Dr. Quinlan, of Hurlet. The salt has been pronounced by competent judges to be a good marketable article, consisting chiefly of carbonate and sulphate of potash, with a small admixture of soda salts. According to the results of experiments described by Dr. Penny, it appears that the soot will yield about 50 per cent. of this marketable salt, containing 43 per cent. of pure potash. It has been found that the amount of potash in soot procured from other iron works is subject to variation, arising, no doubt, from the use of different coals in the blast furnace. From the well known value of potash salts, there is every reason to expect that this discovery will prove of considerable importance to those who are interested in these commercial products, and also to ironmasters, who will be enabled to turn to account a substance which has not hitherto been applied to any practical use.

*From the London Mining Journal, No. 847.

For the Journal of the Franklin Institute.

Performance of the U. S. Screw Steamship "San Jacinto," from Norfolk, Va., to Cadiz, Spain, during the month of March, 1852. By Chief Engineer, B. F. Isherwood, U. S. Navy.

The readers of the Journal are already acquainted with the dimensions of the *San Jacinto*, and with the unusual proportions of her screw propeller, as well as with its results during the few trials which have been made, and which were made under very unfavorable circumstances. An account, therefore, of her further performance will be acceptable.

On the 3d of March, 1852, at 6 A. M., the *San Jacinto* left Norfolk, Va., for the Mediterranean, using steam when the wind was ahead, (about half the time,) up to March 8th, midnight, when the forward bell crank of the starboard engine broke in the neck of the spade handle. The time under steam up to this period was 60 hours; the screw performing under the unfavorable circumstances of head winds and sea, assisted, but in a very small degree, by the sails. The results tabulated from the steam log are as follows:

Date—March, 1852.	Number of hours.	Revolutions of screw and double strokes of engines per minute.	Steam pressure in boiler above atmosphere, in pounds pr. sq. in.	Vacuum in condenser per gauge in inches of mercury.	Throttle open.	Portion of stroke of piston, steam cut off at.	Speed of vessel per hour in knots of 6140 feet.	Cumberland bituminous coal consumed per hour in pounds.	Slip of the screw in per cents of its speed.	Wind, Sea, and Sail.
3,	18	25·2	11·7	24½	$\frac{5}{16}$	½	7·50	2146	28·34	Head wind; no sail set.
4,	18	25·4	12·0	24½	"	"	7·00	2266	33·64	Heavy head wind; no sail set.
"	4	25·4	12·0	24½	"	"	7·75	2266	26·53	Light head wind; fore and aft sail set.
5,	8	24·5	11·5	23⅞	"	"	8·00	2039	21·38	Strong wind and heavy sea forward the beam; fore and aft sail set, and close reefed foretopsail.
6,	4	25·0	12·0	24½	"	"	7·50	1874	27·76	Head wind; no sail set.
7,	9	25·0	11·7	23·4	"	"	6·75	2091	35·00	Strong wind and heavy sea ahead.
8,	8	24·5	11·8	23·6	"	"	9·50	2389	6·63	Strong wind and heavy sea abeam; ship rolling heavily; single reefed fore and main topsail set.
Means,		25·06	11·8	24	$\frac{5}{16}$	½	7·58	2177	27·17	Strong head wind and sea; small amount of sail braced on the wind, used for three-tenths of the time.

The *slips* in the above table are calculated for the mean (42½ feet) pitch of the screw; and it will be at once observed how greatly a small amount of sail, and that on the wind, diminished the slip, showing how much the head winds retarded the speed; for the diminution of slip was more owing to the shifting of the wind from ahead around to a point where the sharply braced sail would draw, than to the effect of that sail.

Another point that will attract attention is, the manner in which the steam was used. The boilers are braced to sustain a working pressure of 30 pounds per square inch, and the cut-off or expansion valve is Sickel's, momentarily adjustable. The most economical manner, therefore, of using the fuel, would have been to carry say 20 pounds of steam in boiler per square inch above atmosphere, cutting off at one-fourth the stroke from the commencement, with the throttle wide open. Instead of that, the steam was used of a pressure of 11·8 pounds only, cutting off at half stroke, being also wire-drawn at the cylinder by a throttle $\frac{5}{16}$ths open. There was likewise a wretched vacuum of only 24 inches of mercury, instead of 27 inches.

From indicator diagrams taken during the trial trip, it appears that closing the throttle to $\frac{4}{16}$ths, caused a difference of 5½ pounds between the boiler pressure and cylinder initial pressure, the engines then making 31 double strokes of piston per minute. Applying the same deduction now, with the throttle $\frac{5}{16}$ths open, and the double strokes 25·06 per minute, the total initial cylinder pressure would be (11·8 — 5·5 + 14·7) 21 pounds, and the mean total pressure throughout the stroke, including effect of steam in nozzles and clearance, would be 18 pounds: allowing the mean back pressure in the cylinders to be 2 pounds greater than in the condensers, the mean effective pressure throughout the stroke would be 13·3 pounds per square inch. The horses power developed by the engine would therefore be

$$\frac{3067{\cdot}96 \times 13{\cdot}3 \times 208{\cdot}83 \times 2}{33000} = 514{\cdot}8.$$

If, however, by better management, the steam were properly used as above suggested, the result would be as follows: Suppose the boiler pressure to be 20 pounds per square inch, and the initial cylinder pressure 18·3 pounds, cut off at one-fourth stroke from commencement, the mean total pressure throughout the stroke, allowing for effect of steam in nozzles and clearance, would then be 20 pounds; and with a condenser vacuum of 27 inches, and a cylinder back pressure greater than this by 2 pounds, as before, the mean effective pressure throughout the stroke would be 16·8 pounds per square inch of piston; and as the double strokes of piston with the same load, are in the proportion of the square roots of the pressures on it, they would become ($\sqrt{13{\cdot}3} : \sqrt{16{\cdot}8} : 25{\cdot}06$) 28·167; and the speed of the vessel being proportional to the double strokes of piston, would then become 8·52, instead of 7·58 knots.

The comparative quantities of fuel consumed in the two cases would be as follows: In the one case, cutting off at half stroke, there would be used per stroke, including amount in nozzles and clearance, 189·5 cubic feet of steam of the total pressure of 21 pounds, and making 25·06 double strokes per minute. In the second case, there would be used per stroke, including same amount in nozzles and clearance, 101·2 cubic feet of steam of the total pressure of 33 pounds, and making 28·167 double strokes of piston. Allowing the advantage of using steam under a higher temperature (growing from the facts that a less proportional amount of water is evaporated to produce it, and that the fuels required are in pro-

portion to the water evaporated only,) to be balanced by the greater loss in radiation, we have for the comparison,

$$21 \times 189{\cdot}5 \times 26{\cdot}060 = 103705{\cdot}77, \text{ or } 1{\cdot}120,$$
$$33 \times 101{\cdot}2 \times 28{\cdot}167 = 94065{\cdot}40, \text{ or } 1{\cdot}000,$$

and the consumption of fuel, which in the first case is 2177 pounds of coal per hour, would in the second case become $\left(\frac{2177}{1{\cdot}12}\right)$ 1944 lbs. per hour, or 20·8 tons per 24 hours, giving a speed at deep draft of $8\frac{1}{2}$ knots against a strong wind and sea.

Owing, however, to their complexity, and the faulty manner in which the engines were designed, it is not at all probable that they could withstand the pressure contemplated, and for which the boilers were intended and could be used. The engines were intended for 36 double strokes of piston per minute, to drive a screw of 37 feet mean pitch; but the Chief Engineer of the *San Jacinto*, (who designed the engines,) apparently convinced of their faulty and weak character, limited the double strokes of piston to 25, carrying low steam, and following far with it. The result is, a far inferior performance to what might have been obtained from the present screw, with strong and efficient engines of the present size.

It will, nevertheless, be satisfactory to compare the actual performance of the *San Jacinto* with the performance of the *Saranac*, (a sister vessel of the same size and built from the same lines,) under nearly the same circumstances. The following is all that is found recorded in the logs of her performance in heavy weather:

SARANAC.

Date.	Number of hours.	Double strokes of engines per minute.	Steam pressure in boiler above atmosphere, in pounds pr. sq. in.	Vacuum in condenser per gauge in inches of mercury.	Throttle open.	Portion of stroke of piston, steam cut off at.	Speed of vessel per hour in knots of $6082\frac{2}{3}$ feet.	Bituminous (Cumberland) coal consumed per hour, in pounds.	Wind, Sea, and Sail.
Jan. 29 to Feb. 1, 1851,	74	11·39	12·8	$26\frac{1}{2}$	$\frac{7}{16}$	0·4	7·410	2626	Moderate head wind; rolling sea; no sail.
Feb. 14 and 15, "	48	12·07	9·0	26	$\frac{9}{16}$	0·5	7·400	2611	Moderate head wind; rolling sea; no sail.
Jan. 29, "	14	11·40	13·5	26	$\frac{1}{2}$	0·4	7·500	1843	Strong wind abeam; chopping sea; sail set.
Feb. 12 and 13, "	36	11·43	8·0	26	$\frac{9}{16}$	0·5	5·725	2187	Strong wind ahead; heavy head sea; no sail.
June 6 and 7, 1850,	48	9·15	10·0	$26\frac{1}{2}$	$\frac{1}{4}$	0·4	5·390	1800	Strong wind ahead; heavy head sea; no sail.

It is necessary to remark here, that the knots of the *Saranac* are $6082\frac{2}{3}$ feet each, as commonly taken in the British and American Navies; while

the *San Jacinto's* log line was expressly graduated to 6140 feet, or a geographical mile.

General Performance of the Saranac.

From all the steam logs of this vessel at the Navy Department, it appears that the *Saranac* has steamed 978 hours, of which 256 hours were under sail and steam, or about one-fourth the time. Weather generally fine, with ordinary swell and winds.

Mean initial pressure of steam in cylinder (by indicator) above atmosphere per square inch,	9·3 pounds.
Cutting off at, from commencement of the stroke, (·0444+)	4 feet.
Double strokes of piston per minute,	12¼
Consumption of Cumberland bituminous coal per hour,	2466 pounds.
Mean effective pressure on piston per square inch (by indicator),	16 "
Horses power developed by the engines,	604·6
Speed of the vessel per hour in knots of 6082⅔ feet,	8·144.
" " " " 6140 "	8·068.

Comparison of the Performance of the San Jacinto with that of the Saranac.

In this comparison, the results are taken to be in the proportion of the cubes of the speed, for the powers employed.

	Powers.	Speeds.	Results or Speeds cubed.
San Jacinto,	514·8 horses, or 1·0000	7·580 knots of 6140 ft.	435·5195, or 1·0000,
Saranac,	604·6 " 1·1744	8·068 " " "	515·1673, or 1·2058,

and $\frac{1\cdot2058}{1\cdot1744}=1\cdot027$, showing the application of the power in the *Saranac* to be 2·7 per cent. better than in the *San Jacinto*. There must, however, be applied to this, a mental correction for the influence of the following facts: That the *San Jacinto's* performance was for very deep draft, and in heavy weather; while the *Saranac's* performance was for mean draft, (that is, with half coal out and other weights full,) and in fine weather. These corrections would make the performance of the *San Jacinto* considerably superior to that of the *Saranac*—a result which might have been expected in sea-going vessels, from a well proportioned screw of 14½ feet diameter, making only 25 revolutions per minute, against a common paddle wheel 27½ feet diameter.

The consumption of fuel was as follows:

San Jacinto,	2177 pounds of coal per hour, or 1·0000
Saranac,	2466 " " " or 1·1328

or nearly in the proportion (1·0000 to 1·1744) of the powers. The boilers, coal, and manner of using the steam, being very similar, this correspondence between power and fuel might have been expected.

Performance of the San Jacinto under Sail alone.

From March 8th, midnight, to March 15th, 8 A. M., the ship was on her course under sail alone, dragging the screw, which being uncoupled, revolved by the reaction of the water. The force and direction of the wind is not given, nor the sail carried; but the mean speed for the whole of the seven days was 7 knots per hour.

Performance of the San Jacinto, with Crippled Machinery.

The air pump of the starboard engine having meanwhile been disconnected, and the exhaust pipe turned up through the hatch of the engine

room, so as to work that engine non-condensing, the engines were again started on the 15th March. The results tabulated from the steam log are as follows:

Date—March, 1852.	Number of hours.	Revolutions of screw and double strokes of piston per minute.	Steam pressure in boiler per square inch above atmosphere.	Vacuum in port condenser in inches of mercury.	Throttle open.	Portion of stroke of piston, steam cut off at.	Speed of vessel per hour in knots of 6140 feet.	Virginia bituminous coal consumed per hour.	Slip of the screw in per cents of its speed.	Wind, Sea, and Sail.
15	8	21·8	13·0	24·7	5-16	½	6·75	2594	25·45	Light breeze ahead; no sail.
21	9	20·7	12·7	25	5-16	"	4·75	2298	44·75	Strong head wind; no sail.
22	15	19·1	11·2	25¼	5-16	"	2·75	2739	65·33	Strong gale ahead; no sail.
23	8	21·7	13·0	24½	6-16	"	5·00	2863	44·52	Strong gale ahead; storm, mizzen, and foretopmast staysail set.
24	24	22·0	13·0	25	6-16	"	6·00	3106	34·33	Strong wind ahead; no sail.
25	10	22·0	12·5	24½	6-16	"	6·30	2866	31·05	Strong wind ahead; no sail.

On the 21st and 22d, about forty fathoms of the port main brace, and also a large hawser, got paid overboard, and coiled around the screw, greatly retarding the speed. After it was cleared, the speed of the vessel increased from 2·75 to 5 knots, under nearly equal circumstances of weather.

On the 25th, at 11 A. M., the *San Jacinto* went into Cadiz for repairs, which would not require more than 10 or 12 working days to perform. Coal is cheap at this port, being delivered alongside the ship at $4·25 per ton.

For a further appreciation of the performance of the screw of the *San Jacinto* in heavy head seas and winds, it may be compared with that of the *Glasgow*, one of the fastest and largest ocean merchant screw steamships. On the passage of this vessel from Glasgow to New York, she made from the 11th to the 19th February, 1852, both inclusive, against a heavy head sea and strong wind, no sail set, 6·157 geographical miles per hour. (Vide *Nautical Standard*, March 27, 1852.) Under the same circumstances, the *San Jacinto's* speed is seen to have been 7·58 geographical miles per hour.

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*Statistics of Gas Works in Great Britain.**

In the United Kingdom, says a contemporary, 855 cities and towns are supplied with gas. Twenty gas-works belong to municipal corporations, or commissioners, and thirty-three to private individuals. 151 companies possess Parliamentary powers, while 682 carry on their business without such powers. (?) The capital invested is 12,300,000*l.*, and the quantity of gas annually manufactured exceeds twelve thousand millions of cubic feet.

* From the London Builder, No. 468.

For the Journal of the Franklin Institute.

Performance at Sea of the U. S. Steamship Fulton. By Chief Engineer B. F. Isherwood, U. S. Navy.*

The following account of the steaming of the *Fulton* from St. Mary's, Florida, to Havanna, during the 3½ days she was making the passage, will show the performance of the vessel at sea under the ordinary circumstances of wind and swell. The mean draft of water was slightly less than the draft with half coal out and all other weights full.

Average steam pressure in boiler per square inch above atmosphere,	28 pounds.
Initial " cylinder " "	26·3 "
Average vacuum in condenser, of mercury,	27 inches.
Steam cut off at, from commencement of stroke of piston,	3 feet.
Mean effective steam pressure per square inch of piston, calculated for 2 pounds greater back pressure than in the condenser, and including expansive effect of steam in nozzles, clearance, &c.,	25 pounds.
Bulk of steam comprised between cut-off valve and piston at one end of cylinder,	3·094 cubic feet.
Double strokes of piston per minute,	19½.
Horses power developed by the engine,	599·5.
Soft anthracite consumed per hour,	2200 pounds.
Speed of the vessel per hour in knots of 6140 feet,	10¾.

Evaporation by the Boilers.

The space displacement of the piston per stroke of 10 feet 4 inches, is 140·9 cubic feet, and for 3 feet of that stroke is 40·644 cubic feet, to which add the space comprised between cut-off valve and piston, 3·094 cubic feet, making a total of 43·738 cubic feet of steam of the total pressure of 41 pounds per square inch, used per stroke; which per hour would become ($43{\cdot}738 \times 19\frac{1}{2} \times 2 \times 60$) 10234·69 cubic feet: to this must be added the loss by *blowing off*, so as to maintain the density of the water in the boilers at $\frac{2}{32}$.

The temperature of steam of the above pressure is 270·6° F., taking the temperature of the hot well at 100° F., and the total heat of steam at 1202° F., (neglecting small corrections, which would be out of place applied to data taken from the ship's log,) the proportion of caloric expended on the water evaporated would be (1202°—100°) 1102°; and on the water blown out (270·6°—100°) 170·6°, which is 13·4 per cent. of the sum (1102°+170·6°=1272·6) of the two, leaving 86·6 per cent. as the amount utilized. Increasing the evaporation in this proportion, we obtain $\left(\frac{10234{\cdot}69 \times 100}{86{\cdot}6}\right)$ 11818·35 cubic feet of steam per hour. The relative volumes of this steam and the water from which it is generated are 664 and 1, which give for the water evaporated $\left(\frac{84504{\cdot}80}{664}\right)$ 177·99 cubic feet. Taking the weight of a cubic foot of sea water at 64·3 pounds, there would be evaporated per hour by 2200 pounds of soft anthracite, ($177{\cdot}99 \times 64{\cdot}3$) 11444·757 pounds of sea water, or 5·202 pounds of water per pound of coal.

* See ante, pp. 195 and 122.

SLIP OF THE PADDLE WHEELS.

The circumference of the centre of effort of the paddle wheels is 72·26 feet; consequently,

$72{\cdot}26 \times 19\frac{1}{2} \times 60 = 84544{\cdot}20$ feet = speed centre effort paddles per hour.
$10\frac{1}{4} \times 6140 = 66005{\cdot}00$ feet = speed of vessel per hour.

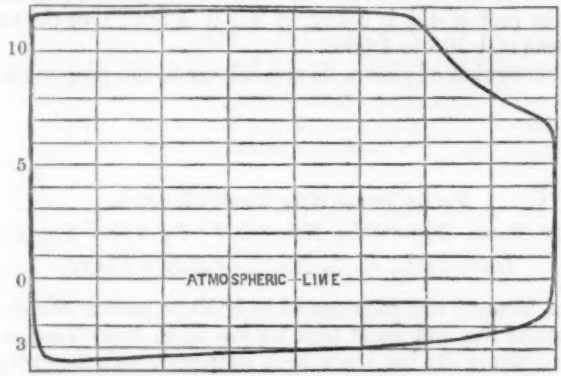
18539·20 feet = slip centre effort paddles per hour, or 21.93 per cent.

INDICATOR DIAGRAMS.

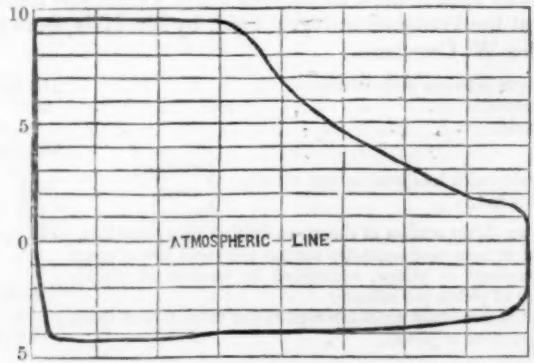
The indicator diagrams are added to show the action of the valves and the manner of using steam. The cut-off is Sickels', and momentarily adjustable. Under ordinary steaming at sea, the blowers are only used occasionally, when cleaning fires, pumping up, &c.

The indicator diagrams were taken in New York Bay, with the vessel deep laden, ready for a cruise.

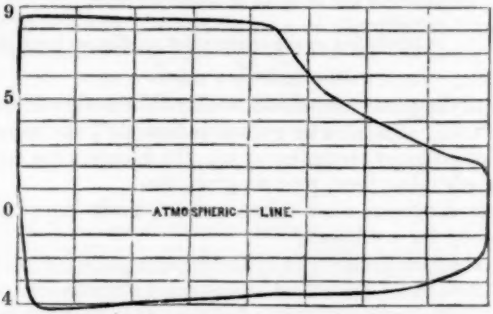
No. 1. Initial steam pressure in cylinder per square inch of piston above atmosphere, 35 pounds; cut off at three-fourths stroke of piston. Mean effective pressure throughout stroke of piston, 41½ pounds. Double strokes of piston, 23 per minute.



No. 2. Initial steam pressure in cylinder per square inch of piston above atmosphere, 29 pounds; cut off at full three-eighths stroke of piston. Mean effective pressure throughout stroke of piston, 30½ pounds. Double strokes of piston, 20 per minute.



No. 3. Initial steam pressure in cylinder per square inch of piston above atmosphere, 25½ pounds; cut off at $\frac{9}{16}$ths stroke of piston. Mean effective pressure throughout stroke of piston, 30½ pounds. Double strokes of piston, 20 per minute.



It will be observed, that the double strokes of piston were nearly in the proportion of the square roots of the effective pressure on it.

The square root of 41½ is 6·442; of 30½ it is 5·523; or the two are in the proportion of 1·166 to 1·000.

The double strokes of piston, 23 and 20, are in the proportion of 1·150 to 1·000.

For the Journal of the Franklin Institute.

U. S. Screw Steam Tug "John Hancock." By Chief Engineer B. F. Isherwood, U. S. Navy. (*With a Plate.*)

The *John Hancock* was constructed in 1850, to answer the double purpose of a steam tug and water tank for the U. S. Navy Yard at Charlestown, Mass., where she has since been stationed, with the exception of a short cruise to the Gulf of Mexico, during the *fillibuster* excitement of the Lopez expedition. On that occasion she was brig rigged, and carried a battery. The results hereinafter given are the mean of her performance at sea, without sail, under ordinary circumstances of weather.

The hull was built at the Charlestown Navy Yard. The machinery was constructed at the Washington Navy Yard, by Mr. Ellis, from the designs of Mr. Charles W. Copeland.

Hull.—Length between perpendiculars,		113 feet.
Beam, extreme,		22 "
Depth of hold,		9 "
Burthen,		208 tons.
Draft of water with half coal in, and all other weights full,	forward,	6 feet.
	mean,	8¼ "
	aft,	10½ "
Immersed amidship section at the mean draft of 8¼ square feet,		154 square feet.
Square feet of immersed amidship section per cubic foot of space displacement of piston, multiplied by number of double strokes of piston per minute,		0·036.
Square feet of immersed amidship section per cubic foot of space displacement of piston,		2·017.

ENGINES.—Two oscillating non-condensing engines.

Diameter of cylinders,	1 foot 8 inches.
Stroke of piston,	1 " 9 "
Space displacement of both pistons per stroke,	7·636 cubic feet.
Mean effective steam pressure per square inch of piston,	25 pounds.
Double strokes of piston per minute,	55½.
Actual horses power developed by the engines,	79·25.

The mean effective pressure is calculated for an initial cylinder pressure of 1·7 pounds less than the boiler pressure, and for a back pressure of 2 pounds greater than the atmosphere, cutting off at three-fourths the stroke from the commencement, and allowing for the effect produced by 0·332 cubic feet of space comprised between the steam valve and piston.

Total weight of engines, including propeller shaft cased in brass, 38,955 pounds.

SUBMERGED PROPELLER (Plate VI.).—One, of bronze, twist-bladed, but *not* a true screw, placed in the stern of the vessel, and connected directly to the engines.

Diameter,	8 feet.
Length of periphery in direction of axis,	3 "
Pitch at periphery,	18·040 feet.
Pitch at hub,	6·310 "
Diameter of hub,	1·250 "
Mean pitch in function of total helicoidal surface,	15·265 "
Mean pitch of the surface comprised between a diameter of 4 feet and the periphery, which may be considered as the *effective* propelling surface, and from which the slip is calculated,	16·739 "
Angle of periphery from a line at right angles to axis,	35° 40′.
Angle at hub from a line at right angles to axis,	58° 7′.
Number of blades,	3.
Total helicoidal area of blades,	44·135 square feet.
Total projected area of blades on a plane at right angles to axis,	30·333 "
Effective helicoidal area (between diameter of 4 feet and periphery),	32·856 "
Effective projected area, " " "	24·488 "
Proportion of the total helicoidal area of the propeller to immersed amidship section of hull,	1·000 to 3·489.
Proportion of the total projected area of the propeller to immersed amidship section of hull,	1·000 to 5·077.
Weight of the propeller,	2830 pounds.
Cost of the propeller,	25 cents per lb.

The following table will show the angles, corresponding pitches, &c., of the helicoidal surface of the propeller at various points from hub to periphery. The calculations are made by supposing that surface to be divided into a number (7) of parallel bands or strips, called elements, which appear as concentric circles when the propeller is viewed as a disk. The *angles* and *pitches* are those normal to the centre lines of the elements. The *pitches* are calculated as the heights of a series of right angled triangles, of which the bases are the circumferences normal to the radii of the several elements, and the angles given made with the circumferences by the hypotheneuses. Were one convolution of the thread used, the whole pitch would be employed, but as less than a convolution is used, only a *fraction of the pitch* is used, and this fraction varies for the different elements according to the length of the propeller at those elements in the direction of the axis. The *total lengths of the elements* are the hypotheneuses of a series of right angled triangles, whose bases are the circumferences, and whose heights are the pitches normal to those elements.

The *length of element used* is the total length multiplied by the corresponding fraction of the pitch.

Radii of elements.	Circumferences normal to radii of elements.	Angles of elements from a line at right angles to axis.		Pitches of elements.	Lengths of elements.	Fractions of pitches used.	Lengths of elem'ts used.	Breadths of elem'ts.	Areas of elements.
A	B $2A\times3{\cdot}1416$	H		C $\frac{B\times\text{sine H}}{\text{sine supplement H}}$	D $\sqrt{B^2+C^2}$	E	F $D\times E$	G	$F\times G$
feet.	feet.	°	′	feet.	feet.	pr. ct.	feet.	feet.	sq. feet.
0·812	5·105	55	33	7·443	9·025	0·600	5·4150	0·375	2·0310
1·250	7·854	52	31	10·242	12·907	0·611	7·8862	0·500	3·9431
1·750	10·995	49	29	12·864	16·122	0·627	10·6101	0·500	5·3051
2·250	14·137	46	27	14·872	20·526	0·700	14·3682	0·500	7·1841
2·750	17·278	43	24	16·431	23·780	0·700	16·6460	0·500	8·3230
3·250	20·420	40	22	17·357	26·800	0·661	17·7148	0·500	8·8574
3·750	23·562	37	20	17·978	29·638	0·573	16·9826	0·500	8·4913
					Helicoidal area of propeller, . .				44·1350

Boiler (Plate VI.).—One iron boiler, with single return ascending flues.

Length of boiler, ...	22 feet.
Breadth, "	6 " 3 inches.
Height, "	7 " 5 "
Contents of circumscribing parallelopipedom, . .	1019·84 cubic feet.
Area of heating surface, ...	755 square "
Area of grate surface, ...	28 " "
Capacity of steam room in boiler, ...	200 cubic "
" " boiler, steam pipes, &c., . .	205 " "
Cross area of the two lower rows of flues, . . .	4·636 square "
" upper row of flues, ...	4·276 " "
" smoke chimney, ...	4·909 " "
Height of smoke chimney above grate, . . .	37 feet 9 inches.
Mean pressure of steam above atmosphere per sq. inch in boiler,	31 pounds.
" " " " cylinder,	28·3 "
Cutting off at, from commencement of stroke, ($\frac{7}{8}$ths stroke,)	15¾ inches.
Space comprised between cut-off valve & piston, (both cylinders,)	0·664 cubic feet.
Double strokes of piston per minute, . . .	55½.
Consumption of bituminous (Cumberland) coal per hour, with natural draft, ...	598 pounds.
Weight of sea water in boiler, ...	22,700 "
" boiler and smoke chimney, ...	26,667 "
" boiler grate bars, ...	2260 "

Proportions.—Proportion of heating to grate surface, . 26·964 to 1·000.

Proportion of grate surface to cross area of the two lower rows of flues,	6·040 "
" " " upper row "	6·548 "
" " " of smoke chimney,	5·704 "
" heating surface to cross area of the two lower rows of flues,	162·856 "
" " " upper row "	176·567 "
" " of smoke chimney,	153·800 "

Square feet of heating surface per cubic foot of space displacement of piston,	13·356.
" " " of space displacement of piston, per double stroke of piston per minute,	0·241.
Square feet of grate surface per cubic foot of space displacement of piston,	3·667.
" " " " " per double stroke of piston per minute,	0·066.
Cubic feet of steam room to cubic foot of steam used per stroke,	25·309.
Consumption of bituminous coal with natural draft per square foot of grate surface per hour,	21·360 pounds.
Sea water evaporated from temperature of 212° F. by one pound of bituminous coal per hour,	7·651 "
Sea water evaporated from temperature of 100° F. by one pound of bituminous coal per hour,	6·938 "
Sea water evaporated from temperature of 212° F. by one square foot of heating surface per hour,	6·061 "

Total cost of boiler and smoke pipe, (26,667 pounds,) $2428·13, or 9·1 cents per lb.

The evaporation is calculated for an initial cylinder pressure of 1·7 pounds less than the boiler pressure; the feed water was by means of a heater furnished to the boiler at a temperature of 212° F.; the point of cutting off was at three-fourths the stroke from the commencement. Three-fourths the space displacement (7·636 cubic feet) of both pistons is 5·727 cubic feet, to which add the spaces comprised between the cut-off valve and piston, 0·664 cubic feet, at one end of each cylinder, and there results (5·727+0·664) 6·391 cubic feet of steam of 43 pounds per square inch total pressure used per stroke; the number of double strokes per minute being $55\frac{1}{2}$, there would be used per hour ($6·391 \times 55\frac{1}{2} \times 2 \times 60$) 42564·06 cubic feet. The relative volumes of steam of 43 pounds per square inch pressure, and the water from which it is generated, is as 635 to 1. The water evaporated would then be (42564·06÷635) 67·03 cubic feet, which, taking the cubic foot of sea water at 64·3 pounds, would be 4310·029 pounds. To this must be added the loss by blowing off at $\frac{2}{3}\frac{2}{2}$. Taking the total heat of steam at 1202° F., and the temperature of the feed water at 212° F., there would be supplied to the feed water by the fuel 990° F. of heat. The temperature of the steam is 273° F.; the difference between the temperature of the feed water and the water blown out is (273° — 212°) 61° F., and as equal quantities of the water pumped into the boiler are evaporated and blown out, the proportion of the heat expended in evaporating will be 990°, and in blowing out 61° F. The total heat furnished by the fuel will be then (990°+61°) 1051°, and of this, 61°, or 5·8 per cent., is lost, leaving (100· — 5·8) 94·2 per cent. utilized, and if 94·2 per cent. evaporates 4310·029 pounds, 100 per cent. will evaporate 4575·4 pounds. The amount of fuel consumed per hour was 598 pounds; consequently one pound of fuel evaporated (4575·4÷598) 7·651 pounds of sea water from a temperature of 212° F.

To obtain the evaporation from a temperature of 100° F., in order to compare it with the results from the boilers of condensing engines, where the feed water is supplied of that temperature, it is necessary to consider that the latent heat of steam is 990°, which increased by 212°, (the temperature of the feed water for which the evaporation has been obtained,) amounts to 1202°; also, the same latent heat (990°) increased by 100°, (the temperature of the feed water for which the evaporation is to be

obtained,) amounts to 1090°. Hence the proportion in the first case between the latent and the sum of the latent and sensible heats is as

990 : 1202, or as 1·0000 : 1·2142,

and in the second case it is as

990 : 1090, or as 1·0000 : 1·1010,

and as the proportion of 1·2142 to 1·0000 gave 7·651 pounds, the proportion of 1·1010 to 1·0000 will give 6·938 pounds.

The ashes, clinker, and refuse of the coal from the furnaces amounted to 12·8 per cent. of the total weight of the coal put into the furnaces.

PERFORMANCE.—Of the entire time of steaming, during one-half there was a light fair wind, and the remaining half a light breeze ahead. Ordinary sea, and no sail set. Speed of the vessel, 6·411 knots of 6082$\frac{2}{3}$ feet per hour. Steam pressure in boiler above atmosphere per square inch, 31 pounds, cutting off at three-fourths the stroke from the commencement. Consumption of best Cumberland (bituminous) coal, 598 pounds per hour. Revolutions of the propeller, and double strokes of engines, 55$\frac{1}{2}$ per minute.

SLIP OF THE PROPELLER.—Taking the pitch of the propeller at 16·739 feet, the slip would be as follows:

16·739 × 55½ × 60	= 55740·870 feet	= speed of propeller per hour.	
6·411 × 6082⅔	= 38995·976 "	= " vessel "	
	16744·894 "	= slip of propeller "	or 30·04 per cent.

Comparison of the "John Hancock" with the U. S. Paddle Wheel Steamer "Spitfire."

Being in possession of the log of the *Spitfire*, (a small war steamer, with a condensing engine, and having about the same resistance of hull as the *John Hancock*,) giving her mean performance at sea, a comparison of the relative efficiency of the two modes of propulsion can be made under the circumstances in which they were intended to be employed, viz: at sea, and loaded and trimmed as war steamers.

		John Hancock.	Spitfire.
HULL.	Length between perpendiculars,	113 feet.	...
	Length on deck,	...	118 feet.
	Extreme beam on deck	22 "	22½ "
	Depth of hold,	9 "	11 "
	Mean draft of water,	8¼ "	7½ "
	Area of immersed amidship section at mean draft,	154 square feet.	154 sq. feet.
	Horses power developed by the engines,	79·250	89·936
	Speed of vessel in knots of 6082⅔ feet per hour,	6·411	6·390
	Slip of propelling instrument,	30·04 per cent.	13·34 pr. ct.

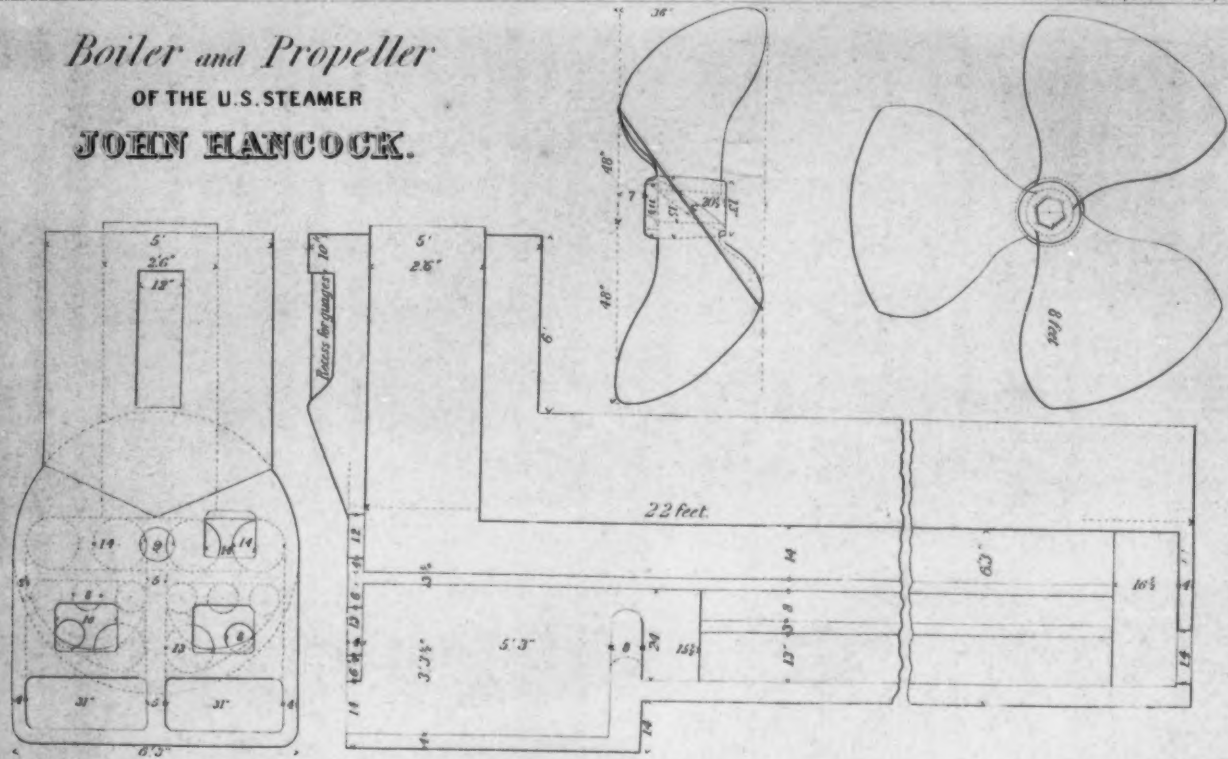
Considering the cubes of the speeds as the measures of the resistances, we have a resistance of (6·411³) 263·498 overcome by a power of 79·250, in the case of the *John Hancock*, and a resistance of (6·39³) 260·917, overcome by a power of 89·936 in the case of the *Spitfire;* and

$$\frac{263\cdot498}{79\cdot250} = 3\cdot325 \text{ and } \frac{260\cdot917}{89\cdot936} = 2\cdot901;$$

Boiler and Propeller

OF THE U.S. STEAMER

JOHN HANCOCK.



consequently the application of the power was better in the *John Hancock* than in the *Spitfire* in the proportion of 3·325 to 2·901, or as 1·0000 to 0·8725, supposing the two vessels to offer equal resistance to the power.

It will be observed that there was a great inequality in the slips of the propelling instruments of the two vessels, that of the *John Hancock* being 30·04 per cent., while that of the *Spitfire* was 13·34 per cent., a difference of 16·70 per cent. The loss by oblique action with the paddle wheel of the *Spitfire* was 18·50 per cent., making the sum of the losses by the paddle wheel (13·34+18·50) 31·84 per cent.

The powers (79·250 and 89·936 horses) exerted in the two vessels were the gross powers developed by the engine. A more accurate idea of the relative efficiency of the propelling instruments will be obtained by reducing these powers to the portions applied to the propelling instruments. The consideration of the friction of the load can be omitted, as it would be proportional to the load.

Beginning with the *Spitfire*, it may be taken that the power required to overcome the friction of the engine alone is 1 pound per square inch of piston, and the power required to work the air pump is 0·7 pound per square inch of steam piston. The mean effective pressure per square inch of piston was 18 pounds. The per centage of power, therefore, lost in working engine and air pump would be $\left(\frac{1{\cdot}7\times100}{18}\right)$ 9·444 per cent., and 9·444 per cent. of 89·936 is 8·494, leaving 81·442 horses.

The engines of the *John Hancock* being non-condensing, their gross power will only have to be reduced by the 1 pound per square inch of piston required to work them. Their mean effective pressure per square inch of piston being 25 pounds, 1 pound would be 4 per cent., and 79·25 diminished 4 per cent. is 76·08 horses.

The comparison of powers with effects or resistances overcome by powers applied to propelling instruments will be as—

$$\frac{263{\cdot}498}{76{\cdot}08}=3{\cdot}4634, \qquad \text{and } \frac{260{\cdot}917}{81{\cdot}442}=3{\cdot}2037;$$

consequently the propeller of the *John Hancock* was more efficient, economically, than the paddle wheel of the *Spitfire*, in the proportion of 3·4634 to 3·2037, or as 1·000 to 0·925.

As the data used in these latter calculations, both of power and resistance, are only general practical averages, and not critically accurate for the particular cases, the results cannot be depended on within a few per cents; consequently we are only entitled to conclude that the two propelling instruments were equally efficacious.

Cost and Weight of Machinery.—The neat cost of propeller, engines, and boiler was $7562·35, in which is included 10,000 pounds of brass castings. Cost of patterns, additional, $487·47. The total weight of propeller, engines, and boiler, exclusive of water, is 70,712 pounds. The engine frames were of wrought iron, with finished columns.

On the Electro-Magnetic Motor of Fessel. By M. PLUCKER.*

It is known that Mr. Page, a physicist in North America, has recently endeavored to produce a motive power by an extended application of the force which attracts a mass of iron within an electro-magnetic helix. Th. Hankel, of Leipzic, has made the same attempt, and has established an important practical law, namely, that this force is as the square of the power of the current. M. Fessel has on his part constructed a model of a machine at my request, the value of which I am not for the moment able to appreciate in case it were made on a large scale, but which as a piece of physical apparatus explains and clears up the application of the force in question.

The model of Fessel is formed of two helices placed end to end in a horizontal position. They serve to conduct the current always in the same direction, but in such a way that it traverses alternately each of the two helices, and consequently only one at a time. In the interior of the helices is a bar of iron, which is alternately attracted from the one into the other by constantly maintaining the same polarity, and which thus executes a motion backwards and forwards. To the two extremities of the bar are fixed two slender horizontal shanks of brass, which rest upon two pullies attached to the two extremities of the apparatus, and which thus support the whole weight of iron. One of these shanks sets a wheel in motion. A commutator is moved by an eccentric by means of a directing-rod, which is placed so as to be able to make the machine move backwards and forwards as in steam-vessels. In one of the machines the commutator has been fixed immediately to the axis.

Two couples of Grove's cells are sufficient to communicate to this apparatus a great rapidity. With six couples, the rapidity became such that it threatened to break the apparatus; and fearing this, I stopped the passage of the current.

I have just received from him the news that he has nearly completed the construction of a new apparatus, in which he has replaced the pulleys by oscillating shanks of metal rod, similar to the oscillating cylinders of the steam engines.—*Bibliothèque Universelle de Genève, December*, 1851.

For the Journal of the Franklin Institute.

Explosion of the Steamboat "Pocahontas." By A. C. JONES, Engineer.

To the Committee on Publications.

On February 18, 1852, the steamboat *Pocahontas*, in backing out from a wood yard on the Arkansas river, collapsed both flues of the middle boiler, scalding eighteen persons, of whom eight died within a few hours after. The three boilers are two years old, 28½ feet long, 38 inches in diameter, with 14-inch flues. By inspection, I found that half of each flue is torn from the after head; one flue is flattened vertically, and the other one horizontally; the end sheet of one is much laminated, and has been burned in turning the flanch on it. The iron is scant one-quarter inch thick;—this is entirely too light, particularly if they carried the steam

* From the Lond., Edinb., and Dublin Philosoph. Magazine, February 1852.

to the extreme of the pressure gauge, (200 lbs.) The time elapsed has obliterated the marks of the water line—the flues appear as if they had been partially overheated. The position of the gauge cocks in the outside boilers show that these were worked on the scant water system. The middle boiler has *no gauge cocks in it*, and yet the inspector's certificate, dated New Orleans, January 24, 1852, pronounces them in good order! The shell is uninjured, and no other damage was done to the boat.

For the Journal of the Franklin Institute.

Notes on the Steamship "State of Georgia." By J. V. Merrick, Esq.

(With a Plate.)

This steamer, before noticed in this *Journal*, has recently been completed, and will leave this port as pioneer of the line to Savannah, Geo., on the 12th of May. Her engineer's trial trip was made on the 27th and 28th April, 1852, and an account of her performance, with the principal dimensions, &c., will doubtless be interesting to many readers.

Hull constructed by Vaughan & Lynn, Kensington.

Length on deck,	210 feet.
" between perpendiculars,	200 "
Breadth,	33 "
" over guards, (extreme,)	56 " 10 inches.
Depth of hold,	21 "
Depth of lower hold,	13 "

Rigged with three masts; three square sails on foremast; fore and aft sails on main and mizzen mast.

Draft, loaded, estimated at 12 ft. 6 in., to 12 ft. 9 in., which is about 6 inches more than was intended, owing to the unusual size and weight of timbering.

Machinery constructed by Merrick & Son, Southwark.

Space occupied in lower hold, by machinery and full complement of coal (155 tons,) is 54 feet 9 inches long, and whole width of ship as follows:—

Engine space, 13½ feet wide, with bunks on each side,	30 feet 9 in.
Fire room,	8 " 3 "
Boilers,	14 "
Passage forward of boilers,	1 " 9 "
Total,	54 " 9 "

Between decks, space 12 feet 3 inches wide, and 46 feet long; centre of shaft, 80 feet forward of stern post.

Engine, single side lever, with condenser below cylinder; air pump on same end, and outside steam chests having balance valves.

Cylinder,	72⅜ in. diam. 8 ft. stroke.
Nominal horse power,	220·6
Air pump,	46½ in. dia., 37 in. stroke.
Lead on steam valves (lift,)	¼ inch.
Lead on exhaust valves (lift,)	13-16 inch.

Is fitted with H. Allen's momentarily adjustable cut-off arrangement.

Paddle Wheels, ordinary radial, with single floats.

Diameter over floats,	29 feet 4 inches.
Width of "	9 " 3 "
Depth of "	1 " 10 "
Number of " 28	
Mean dip on trial,	4 " 4½ "

BOILERS (Plate VII.); two return tubular, natural draft; dimensions of each:

Length,	14 feet.	
Width,	12 "	
Height,	10 "	10 inches.

240 tubes of 3 inches inside diameter; 9 feet 6 inches long.
4 furnaces with brick bridge walls.
Heating surface, (to 12 inches above tubes.)

4 Furnaces and back connexions,	452	square feet.
Tubes,	1774	"
Front connexion,	76	"
Total in each,	2302	"
" both,	4604	"
Grate surface,	145	"
Cubical contents, (without drums,)	2077	cubic feet.
Water space, (to 12 inches above tubes,)	1374·4	"
Steam space, including drums,	1017	"
Weight of each boiler,	38,600	pounds.
" water in each boiler,	43,980	"
" each boiler filled,	82,580	"

or, 73¾ tons total for both.

SMOKE STACK.—

Diameter,	5 feet	9 inches.
Total height above bars,	60 feet, as follows:	
From bars to centre of tubes,	3 feet	9 inches.
" centre of tubes to top of drum,	15 "	3 "
" top of drum up,	41 "	
	60 "	0 "

PROPORTIONS.—

Heating surface to cubic foot of cylinder,	20·40 to 1·00
" " grate surface,	31·75 " 1·00
" " pounds fuel per hour,	2·39 " 1·00
" " nominal horse power,	20·93 " 1·00
Grate surface to area over bridge,	1· " 0·127
" " area in tubes,	1· " 0·163
" " " chimney,	1· " 0·180
Steam space to cubic foot of cylinder,	4·5 " 1·00

PERFORMANCE.—Trial Trip made down the Delaware river and out to sea.

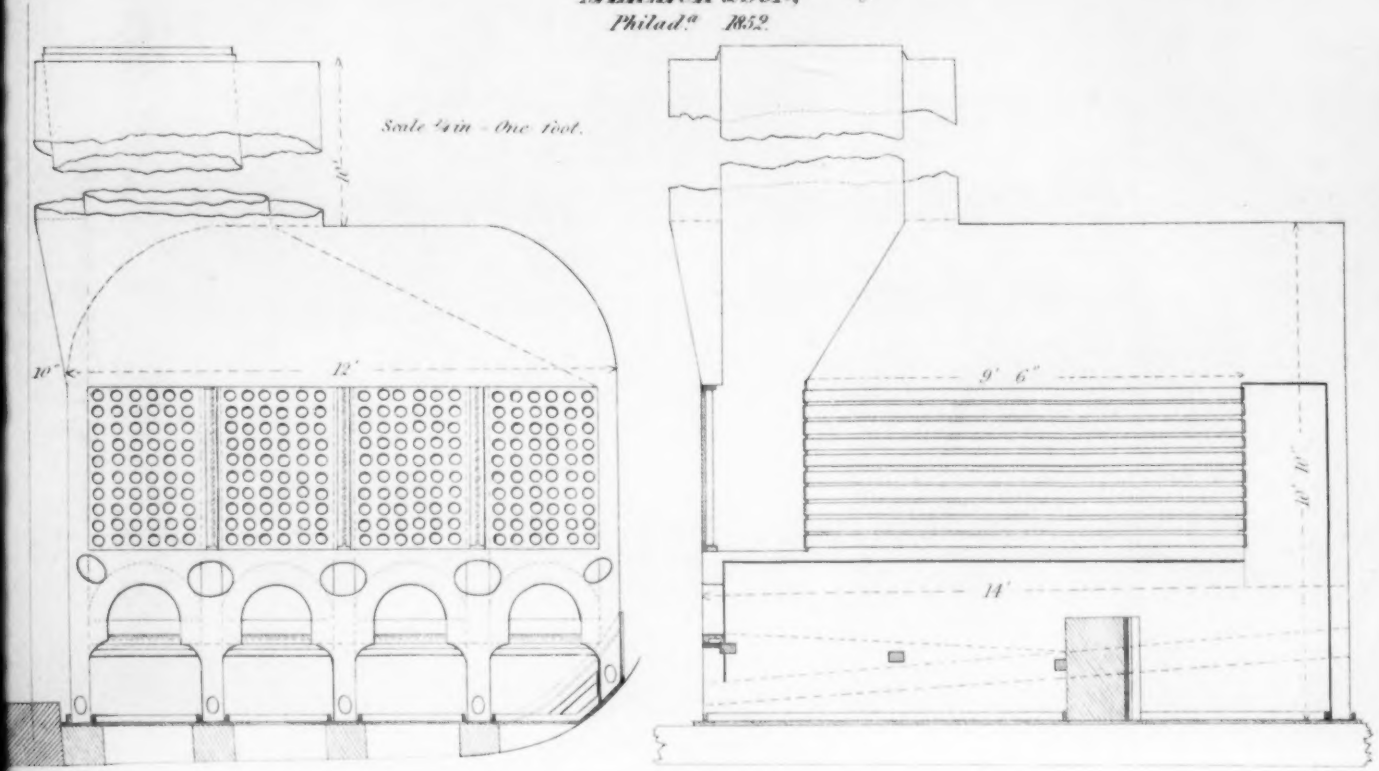
Mean draft of water on trial, forward,	10 feet 7 inches.
" " aft,	12 " 5½ "
" " mean,	11 " 6¼ "
Midship section immersed at that draft,	345·5 square feet.

Time and distance made; downward trip.—April 27.

	Time.			Distance from starting point.	Tide and other rem'ks.
Passed Navy Yard Shears,	9h.	15 m.	A. M.	Miles.	Ebb almost ½ down.
" Fort Mifflin, (stopped 10 min.)	9	50	"	8·25	"
" Marcus Hook,	10	51	"	20·25	"
Stopped twice below Marcus Hook to repair disarrangement of valve gearing; in all	2	48			Met flood at 1 P. M. 30 miles below city.
" Delaware City,	2	51	P. M.	40·50	
" Ledge Lightboat,	6	8	"	77·00	Took ebb tide.
" Breakwater Lighthouse,	7	48	"	103·50	
Total time,	10	34			
Running time,	7	36		103·50	

Boilers of Steamer State of Georgia.

BY
MERRICK & SON,
Philad.a 1852.



Estimating the tide current $2\frac{1}{2}$ miles per hour, in favor $4\frac{1}{4}$ hours, and opposed $3\frac{3}{8}$ hours, the actual distance run was 103·5—2·2=101·3 miles, or, in still water, speed per hour was $\frac{101{\cdot}3}{7{\cdot}6}$=13·33 statute miles.

Time and distance made, April 28.

Passed Breakwater Lights,	6	h. 3	m. A. M.	on S. E. course.	Moderate breeze from
Put about,	7	48	"	about 22 miles out.	S. W., and light swell; at 7 30, wind veered to the westward and came out strong from N. N. W.
Passed into Breakwater,	10	3	"		Tide ebb; wind nearly
Rounded past Lewes, Dela.					ahead; continued till
" out of Breakwater,	10	20	"		below Reedy Island,
(Stopped 9 minutes.)					(3 30, P. M.); after
" Ledge Light-boat,	12	49	P. M.	26·50	which, wind abeam to the City.
					No tide till 4 h. 15 m.
" Delaware City,	3	50	"	63·	when flood tide over-
" Marcus Hook,	5	15	"	83·	took the vessel.
" Fort Mifflin,	6	5	"	95·25	Tide moderate, owing
" Navy Yard,	6	37	"	103·50	to N. W. wind blowing all day.
Total time,	8	17			
Running time,	8	8			

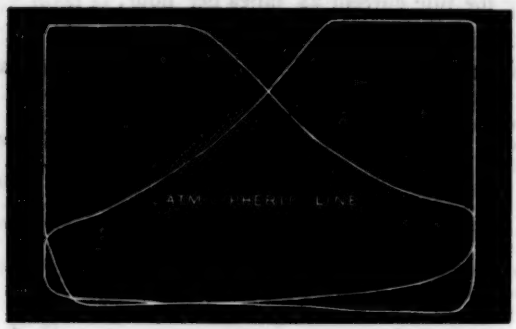
The force of the wind may be estimated by comparing the time running out and returning (22 miles,) at sea. 22÷1·75=12·57, and 22÷2.25 =9·77 miles per hour; difference owing to wind on return=2·8 miles per hour. On the upward trip, tide in favor 2 h. 22 m., opposed 2 h. 42 m. Actual distance run, 103·5—0·7=102·8 miles in 8 h. 8 m., or $\frac{102{\cdot}8}{8{\cdot}13}$= 12·66 statute miles per hour. Assuming the retardation from the wind at 2 miles per hour only, for one half the running time, would give the speed =13·66 miles per hour.

The average pressure in boilers, pressure in cylinder, (from indicator cards,) number of revolutions, point of cutting off, &c., were as follows:

	1. Total duration. *Hours.*	2. Pressure of steam above atmos. *Boilers.*	3. Mean pressure above atmos. *Cylinder*	4. Effective pressure on piston.	5. Revols. per minute.	6. Mean point of cutting off.
Downward trip, ...	8·45	20·52	17·80	20·34	16·17	3 ft. 2 in.
Going to sea, &c. . .	4·27	21·50	16·75	19·95	14·80	3 " 1 "
Upward trip, ...	8·08	20·47	17·32	19·95	16·50	3 " 2½ "
Average in river, . . .	16·53	20·50	17.56	20·15	16·28	3 " 2¼ "
Average in whole trip, .	21·20	20·70	17·40	20·10	16·05	3 " 2 "

There were taken during the trip, about 30 indicator diagrams, (of which four examples are given,) from which the above results were carefully averaged. The 3d column is the *average* pressure during admission of steam, and of course covers the effect of "wire-drawing."

No. 1.



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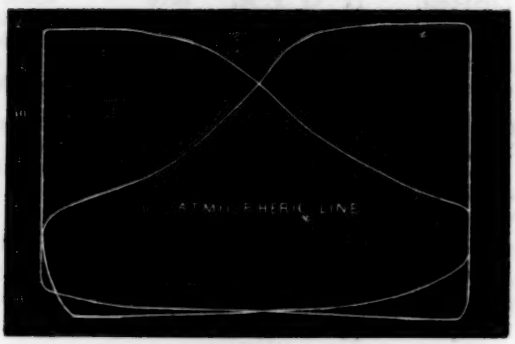

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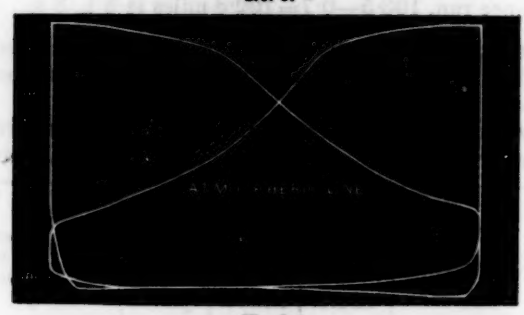

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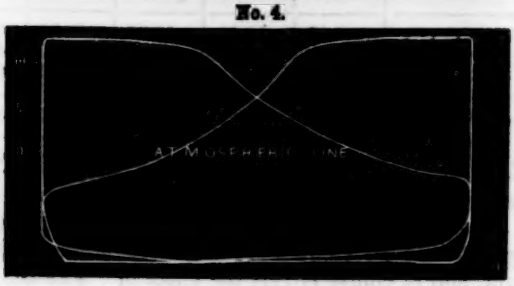


No. 1.—Taken at 3 h. 8 m. P. M., April 28th, Delaware River; revolutions per minute, 17; steam pressure in boilers, 21 lbs., cutting off at 2 ft. 10 in.; vacuum, 26 inches; throttle $\frac{5}{8}$-ths open; average effective pressure, $= \frac{21{\cdot}34+21{\cdot}23}{2} = 21{\cdot}29$ lbs.

No. 2.—Taken at 4 h. 48 m. P. M., April 27th, Delaware Bay; revolutions per minute, 18; steam pressure in boiler, $22\frac{1}{2}$ pounds, cutting off at 3 feet 4 inches; vacuum, 26 inches; throttle $\frac{3}{8}$-ths open; average effective pressure, $= \frac{22{\cdot}65+22{\cdot}03}{2} = 22{\cdot}34$ pounds.

No. 3.—Taken at 8 h. 55 m. A. M., April 28th, at sea; going in Capes, strong wind on port bow; revolutions per minute, 14; steam pressure in boilers, $20\frac{1}{2}$ pounds, cutting off at 3 feet; vacuum, 26 inches; throttle $\frac{3}{8}$-ths open; average effective pressure, $= \frac{19{\cdot}31+19{\cdot}38}{2} = 19{\cdot}35$ pounds.

No. 4.—Taken at 5 h. 30 m. P. M., April 27th, Delaware Bay; foretopsail and top gallantsail set; moderate breeze abaft starboard beam; revolutions per minute, $16\frac{1}{4}$; steam pressure in boilers, $14\frac{1}{2}$ pounds, cutting off at 3 feet 2 inches; vacuum, 26 inches; throttle $\frac{3}{8}$-ths open; average effective pressure, $= \frac{17+16{\cdot}75}{2} = 16{\cdot}87$ pounds.

Power developed and utilized.—Diameter of wheel at centre of pressure, at 4 feet $4\frac{1}{2}$ dip, $= 27{\cdot}68$ ft. = circumference 86·96 feet.

Downward trip; distance traversed by centre of pressure, . . .	$86{\cdot}96\times16{\cdot}17\times60\times7{\cdot}6$	= 641193
Actual distance traversed by vessel,	$101{\cdot}3\times5280$	= 534868
Slip = 16·58 per cent.		= 106325
Upward trip; distance traversed by centre of pressure,	$86{\cdot}96\times16{\cdot}50\times60\times8{\cdot}13$	= 700194
Actual distance traversed by vessel,	$102{\cdot}8\times5280$	= 542788
Slip = 22·48 per cent. (Head winds for one-half distance.)		157406

Or, if the deduction for the effect of wind (before alluded to) be made, the slip in still water would be 16·44.

Mean slip on both trips $\frac{16{\cdot}44+16{\cdot}58}{2} = 16{\cdot}51$ per cent.

And mean speed " $\frac{13{\cdot}33+13{\cdot}66}{2} = 13{\cdot}50$ stat. miles per hour.

Average power developed in the same time was $\frac{4114\times20{\cdot}1\times16{\cdot}28\times8\times2}{33000} = 652{\cdot}69$ horse power; or allowing $1\frac{1}{2}$ lbs. per sq. in. on piston for working engine, and 5 per cent. on the remainder for friction of load, we find $= \frac{4114\times18{\cdot}6\times{\cdot}95\times16{\cdot}28\times16}{33000} = 573{\cdot}66$ horse power transmitted through the shafts; which at $86{\cdot}96\times16{\cdot}28 = 1415{\cdot}7$ feet per minute (velocity of wheel) becomes a pressure tangential to the circumference, of 13451 pounds. From oblique action of floats, (causing a loss of 17·5 per cent. at 4 feet $4\frac{1}{2}$ inches total dip,) this is equal

to a pressure available in propelling in a line parallel to the keel, of 11097 pounds, which is the resistance of the vessel at a velocity of $\frac{1415{\cdot}7\times{\cdot}835}{60}=19{\cdot}7$ feet per second.*

Hence, coefficient of vessel $=\frac{11097}{(19{\cdot}7)^2}=28{\cdot}60$, at this speed and in still water.

The proportion of total power utilized in propulsion is as 652·69 : $\frac{1415{\cdot}7\times{\cdot}835\times11097}{33000}=652{\cdot}69 : 397{\cdot}47$, or as 1·00 : 0·609, or nearly 61 per cent.

Consumption of Fuel.—Good Buck Mountain, (anthracite.)

An accurate record of coal used, was kept during the trip. From the time of leaving the wharf to the time of returning to it, there were consumed 398 buckets, each weighing 103 lbs. = 40994 lbs.; of this it is supposed that 1000 to 1500 lbs. was used in banking fires at the Breakwater, from 8 P. M. to 6 A. M., April 28, and in raising steam; that being a matter of uncertainty, however, may be neglected, and we find for the consumption $\frac{40994}{21{\cdot}3}=1922$ lbs. per hour; 21·3 hours being the whole time during which the engine was working.

Evaporating Effect.—

Average point of cutting off, . .	3 feet 2 inches of stroke.
Clearance at each end of piston, . .	1·25
Space in each nozzle and steam chest, .	2
Total admission each single stroke,	3 " 5·25 inches "

Then volume of steam used per minute, $=3{\cdot}4375\times2\times16{\cdot}05\times28{\cdot}27$ = 3120 cu. ft.; average pressure, (see table,) 20·10 pounds, of which volume = 827, so that

$\frac{3120}{827}=3{\cdot}772$ cu. ft. $\times 62{\cdot}5=235{\cdot}75$ lbs water evap. per min.

and $\frac{1922}{60}=$ 32·03 lbs. coal used "

$\frac{235{\cdot}75}{32{\cdot}03}=7{\cdot}360$ for fresh water.

For about one-fifth of the time (at sea,) the water was maintained at $\frac{1{\cdot}5}{32}$,

*A convenient formula embodying this calculation is,

$$C=\frac{A\,P\,L.\ \sin.^2\delta}{{\cdot}0043\ D^3\ R^2\ (1-s)^2}$$

When C = coefficient of vessel.
A = area of cylinder in inches.
P = pressure in cylinder effective for propulsion, after deducting for working engines and friction.
L = length of stroke in feet.
D = diameter of wheels at centre of pressure in feet.
R = revolutions per minute.
s = per centage of slip.
δ = angle of which the sine is the mean of the sines of all the angles contained within the limits of unity and the entering angle of the floats in the water.

which at a temperature of 110° feed water, and 260° in the boilers, causes a loss of 16·9 per cent. in the whole amount, during one-fifth the time, or for the whole time, $\left(1+\frac{16{\cdot}9}{83{\cdot}1\times5}\right)\times7{\cdot}360 = 7{\cdot}660$ lbs. water to a pound of coal.

No foaming was observed in the boilers during the trip.

For the Journal of the Franklin Institute.

Explosion of the Steamer Redstone. By Thomas Bakewell, Esq.

To the Committee on Publications.

The steamer *Redstone*, on which the explosion occurred, was a new boat, built at Brownsville, Pa., with three boilers, 42 inches diameter, and two flues, each 15 inches diameter. She plied as a packet between this place and Madison, 100 miles below, and was owned by parties in that place. The explosion happened 12 miles this side of Madison.

I have annexed the answer to my letter of inquiry to Mr. Sopher, the Clerk of the boat. The Captain may in a few weeks be able to visit this City, when I shall not fail to see him.

You will please observe that Mr. Sopher states that "the opinion of Captain Pate was, that the water must have been too low." This "opinion" arises not from any facts justifying it, but is a sample of the prevailing idea, that boilers cannot burst with plenty of water.

There can be no question in this case, that the accumulation and retention of steam under the constant expectation of being able to "go ahead," and then the prolonged delay of the engine hanging on the centre, was the cause of the explosion.

I enclose a newspaper account of the explosion of the *Redstone*, and also that of the *Glencoe* at St. Louis, giving the *testimony* of an assistant engineer, (say opinion of himself and friends,) as to the cause. This newspaper slip of the St. Louis explosion was shown to me as the strongest case known, conflicting with my views of explosion, viz: that boilers burst simply from excess of steam, and that want of water contributes only so far as the metal may be heated and weakened thereby; that in no case of water on a heated part of a boiler, can steam be generated in quantity so suddenly as to explode the boiler, without previous indications by the safety valve, or any approach to it, although steam *may* be generated from that or other cause more freely than the safety valve will *continue* to discharge under its usual weight.

The very disastrous explosion of the boilers of the *Moselle* at this place in 1836, was followed by the usual newspaper statements and verbal gossip, of want of water, boilers red hot, hydrogen gas, &c.; and persons were ready to testify to pieces of the boilers being red hot, as they flew through the air.

The boilers, as arranged in the boat, side and side, about 3½ inches apart, are connected near the fire end by a double concave cast iron washer, 7 inches diameter, with a hole in the middle, 2 inches diameter, to meet corresponding holes in the boilers, for a water passage, the joints between each side of the washer and boiler being made with lead. This

kind of joint is over the fire, and apt to give trouble in ordinary circumstances by the lead melting out.

Now, a piece of each of the two boilers, still connected as above described, was found and examined by myself and others, the lead joints of which were perfect. We also found the lead joints of the manhole and connecting cross pipes in their original perfect state.

From the above facts, it is evident that the water must have been at least three inches above the middle of the boilers, which would cover (or nearly so) the flues.

Cincinnati, April 22, 1852.

Letter from Mr. Sopher.

The *Redstone* left Madison at 12 o'clock, 3d of April, for Cincinnati. She took in tow at the time a loaded corn boat, containing about 2000 bushels, for Carrollton, a distance of 12 miles, and made it in the usual time, say one hour and thirty minutes. After leaving the corn boat, we landed at the wharf, and remained fully ten minutes, taking on eight passengers. We then got under weigh, and after running 3½ miles, landed at Scott's Farm, on the Kentucky shore, where we took on the Rev. Perry A. Scott.

At the time the wind was blowing hard ashore, and instead of backing out as usual, she only commenced backing down the shore, the wind preventing. The Captain then gave the order to stop backing, and go ahead on the starboard wheel, that being the wheel next the shore. Instead of going ahead, the engine "caught on the centre," and whilst the engineer was working the levers, two of the boilers exploded.

I am unable to say how much steam we had on at the time, but usually carried 140 pounds, and have had as high as 170 pounds, which was the most I have ever known. Nor can I tell you any thing in regard to the water, as the first engineer of the watch was killed. The opinion of Capt. Pate was, that the water must have been low.

Aurora, April 30, 1852.

Extract from the Newspaper Account.

The question naturally arises as to the cause of the explosion. It is a notorious fact, that she has been "shoved," and in for a race, whenever she came across another steamer, making it a rule to pass her under weigh if possible. The following paragraph from the Madison *Courier* of Saturday tells its own tale:

"The steamer *Redstone* came in last night with some eighty passengers and a fair freight list. The *Redstone* is one of the fast *ones*, as the crack steamer *Buckeye* found out yesterday, after laying out in the river to wait for her. The *Redstone* took her on the wing—passed her under weigh easy. Captain Pate is very much elated—thinks of making a fast run from Louisville to Cincinnati."

From all the information we can gather, the boat was heavily charged with steam, in case another steamer came along, and the consequence was, the explosion of the boilers on the fourth revolution of the wheel.

The Cause of the Explosion of the Steamer Glencoe.

We made mention in yesterday's issue of the fact, that Mr. John Ryan, one of the assistant engineers on the steamer *Glencoe*, had made some

dying declarations in relation to the explosion of the boilers of this ill-fated boat. Yesterday noon we met with two brothers of the deceased, who were present when these disclosures were made, and from them glean the following facts, in substance the same as said by Ryan on his death-bed.

A short time previous to his death, Mr. Ryan called those into his room, among whom were his two brothers, residents of Alton, Mr. Samuel Rogers, a respectable brass founder on North Main street, and others, and told them that he desired to make a statement previous to his death, which he felt assured was near at hand.

He then went on to state that, on the evening of the arrival of the *Glencoe* at this port, himself and George Buchanan, first engineer of the boat, were on watch. Some time before reaching port, he (Ryan) tried the water in the boilers, and found it very low, and called to B., and informed him of the fact, and received some evasive answer. He again tried the water, and again called to Buchanan, who told him to mind his business, that there was water enough in the boilers, and he would take her with it to St. Louis or to h–ll.

Not satisfied, Ryan expostulated, and Buchanan told him in substance that it was his (Buchanan's) watch, and that he (Ryan) had nothing to do with pumping up, and, moreover, that if he (Ryan) had his way, he would have the water from the boilers running out at the tops of the chimneys. Subsequently Buchanan remarked that the boat was making good time, and he would take her into St. Louis kiting. This was perhaps the last remark made, and when the boat reached the wharf, and commenced trying to effect a landing, Buchanan turned on the gauge-cock, and let on the water. The instant the cold water came in contact with the heated boilers, now nearly dry, the explosion took place.

This statement was made, we understand, over three or four times, at the solicitation of the dying man's friends, who thought, perhaps, his mind was wandering. He was told the weight and importance of his declaration, and was asked if he was not out of his right mind; to which he replied, that he was perfectly conscious of what he was saying and doing; that his declaration were facts, and that he designed making the same statement in the event of his recovery, and now that he felt conscious of his approaching end, he was the more anxious to unburthen his mind. In a short time after, Mr. Ryan breathed his last.

We give the facts substantially as related to us, without exaggeration. Comment is unnecessary, the declarations speak for themselves.

St. Louis Intelligencer, April 9.

For the Journal of the Franklin Institute.

Explosion of the Steamboat "Mary Kingsland." By A. C. Jones, Eng'r. (*With a Plate.*)

To the Committee on Publications.

On February 29th, 1852, at 6 o'clock, A. M., about 30 miles below New Orleans, the tow boat *Mary Kingsland* exploded the starboard middle boiler. She had in tow, a ship, a barque, two brigs, and a schooner, and

was running steadily at the time of the explosion. Eight persons died from injuries received, and much damage was done to the boat and engine.

The *Mary Kingsland* was originally a ship, which was burned to the water's edge, and since being converted into a tow boat, has had three explosions on her,—one about a year since, after which four of the six boilers were replaced with others, the one marked *a*, (Plate VIII.,) and the one now destroyed being the old ones; their after heads are *half* cast iron. These two have a water space between the flue and shell of 3½ inches; the others have only a space of *one and a half inches.*

The diagram gives the position of the iron fragments of the boiler and its appendages. As the force of the explosion was upwards and aft, of course much of the woodwork is destroyed. *b* is the foremast, *c* is a large piece of the shell, flattened and partly doubled up; many fragments of the front cast iron head is attached to it; *d* is the two starboard boilers, bottom upwards, the chock joint (forming the water connexion between them) being in good order. Above the other boilers, at *e*, is two-thirds of the steam drum, and its steam connexion pipe; all the joints have been torn from the tops of the boilers. Forward of this, on the top of the fragments of the boiler deck, is an upper section of one smoke pipe, uninjured; at *f*, on the main deck, is the other smoke pipe, in good order. The breechen of these pipes is only partially injured. *g* is part of the standing pipes, through which the supply of water from the pump passed to the boilers; *h*, a piece of flue, (round,) much torn at one end; the other end has nine-tenths of the holes in good order. *i*, is a straight flat piece of the shell, the widest part being 23 inches; this piece is nearly a foot longer than is due to the perimeter of the boiler. Near this is a piece of flue, *k*, about 18 inches long, with some fragments of the front cast iron head attached to it. About eight feet abaft this, *l*, is half of the cast iron front head of the boiler; all the holes in the rim are in good order. About ten feet further aft, we come to the principal part of the boiler, its after end resting on the paddle wheel shaft. Fig. 2 gives the shattered appearance of the end, both the cast and wrought iron part of the head being much ruptured. Ten feet of this shell retains its cylindrical form, except a large flattened piece, which stands out at a tangent from it. The shell is much corroded, and there are two large patches on the bottom, and a small one on the side. The iron is much laminated, and appears of a very bad quality. The highest water line inside shows that this boiler had been worked with *the water just covering the flues;* one gauge cock is two inches above the line of the flue tops, and the other one and three-quarter inches above it. What had been the inboard flue, *m*, is collapsed its whole length, 18 feet; the other flue, 17 feet 6 inches long, is cylindrical; half the rivets at its end are cut clean off, and remain in the holes; another part has a piece of flue sheet torn off outside the rivets; *n* is a piece of flue unchanged in form, 8 feet 6 inches long, having a hole in its side, about the size and shape of a man's hand; this piece of flue is exactly at right angles to the part of the flue in the shell, and singularly, the end *o* belongs to the end of the flue still fast to the head of the boiler. At *p*, under the flues, lies the manhead in a perfect state.

New Orleans, April 2, 1852.

Explosion of the
MARY KINGSLAND.

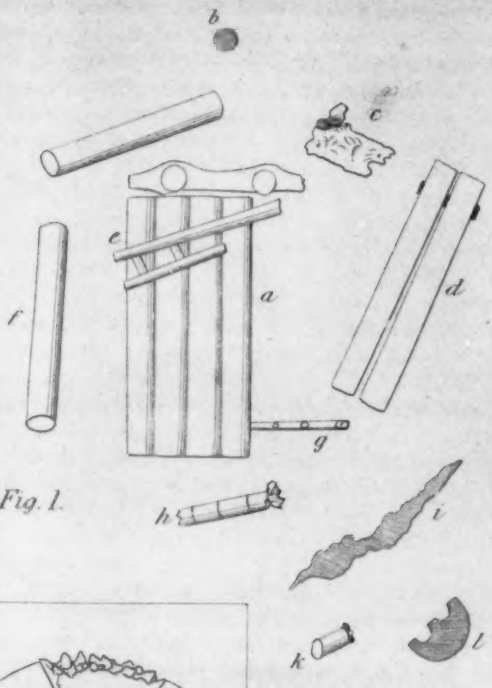


Fig. 1.

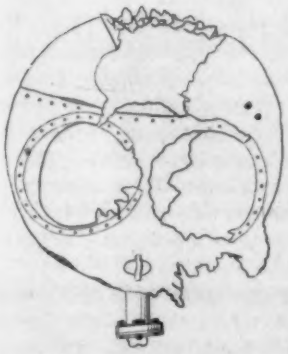


Fig. 2.

For the Journal of the Franklin Institute.

On Marine Propulsion. By J. V. Merrick.

It appears from the last "Reply" of Mr. Nystrom, published in the May number, that he is still unable to understand the true theory on the slip question. Possibly this might not have been the case, had he read attentively what he professes to criticize; in which case he would not have compelled me to notice one or two instances of misrepresentation, which are evidently the result of carelessness in reading.

The first passage to be noticed reads as follows:

"Now, after Mr. M.'s lengthy disquisition, "that slip is no loss of effect," he comes to the conclusion of my first formula: $p\ v = r\ s$, or, as Mr. M. expresses it, $p : r = s : v$, in which

p = coefficient of the vessel.
r = area of floats multiplied by the coefficient for resistance to plane surfaces.
v = velocity of the vessel.
s = velocity of the water backwards (slip).

This is a proof that slip is *no* loss of effect. The effect delivered from the steam engine $r\ s = p\ v$ the useful effect.

After Mr. M. has embodied the formula, he condemns it as wrong, and says it should be $p = r$.

If Mr. M. had substituted *resistance* of the vessel instead of *coefficient*, it would have been all right. But this "coefficient" makes the remainder of his article wrong."

If Mr. Nystrom will turn back to his own article in the March number, p. 200, he will find the following notation, which precedes the equation commented upon:

"p = mean thrust of dynamometer in pounds;
r = resistance to the propeller in pounds," &c., &c.

If he will then read again the definition given of the term "coefficient," (vide note, foot of p. 272,) and the examples given to illustrate it in the case of the *San Jacinto*, he will see that (the same notation being adopted) $p = Cv^2$, when C = coefficient of the vessel, and v its velocity, and that p and r are simply convertible terms, since the resistance of the propeller in pounds is precisely the same as that of the vessel in pounds; in other words, the 12,815 pounds measured by the dynamometer of the *San Jacinto*, expresses either the pressure of the propeller backward against the water, or the resistance opposed by the vessel at the velocity at which it was moving forward—one of the very *elementary* principles in mechanics.

The assumption, therefore, that I have first condemned and then embodied Mr. Nystrom's formula, is entirely gratuitous.

To have substituted, as he suggests, the term, *resistance* for *coefficient*, would have been correcting (?) that which was right before.

Again: in the course of his remarks, Mr. N. indulges in some facetious observations respecting "square radius," and "square degrees," based upon a typographical omission in the text; for a correction of which he is referred to the "Errata" in the May number. Notwithstanding this omission, the result obtained was correct, as a little calculation would have shown him.

In this connexion it may be remarked, that although the projected area of the *San Jacinto's* propeller was inadvertently misquoted, an examina-

tion of the context will show what was *intended*. The error affected only that particular case, and not the principle involved; showing only that a higher coefficient for the resistance of plane surfaces obtained in that instance, than ·845, which was therein deduced. The true coefficient was 2·347.

But to prolong this discussion will be of little avail: the arguments, *pro* and *con*, are before those who take any interest in the subject. I shall, therefore, conclude what I have to say, by showing to Mr. Nystrom the fallacy of the argument on which he relies for proof—an argument on which he appears to have expended a vast number of figures and equations.

To demonstrate this point, we have only to examine the diagrams by which the argument is illustrated.

We there find that a fulcrum, which has always been supposed to be a point of support for the action of the power, in propelling a vessel as well as in moving any other resistance, is an imaginary point in the area of a paddle wheel, situated somewhere between the shaft and the immersed float—the position of this point being determined merely by the ratio between the advance of the vessel and the slip. This is a very convenient (for the argument) and quite original method of viewing the lever. There is only one trifling circumstance overlooked, which is, that the "fulcrum" moves over space in the same direction and with the same velocity as the resistance.

To those who are content with the old method of considering the lever, it is easier to suppose that the fulcrum is in the water; that this fulcrum recedes a certain proportion of the whole movement due to the power; and that the resistance is moved over a space equal to the difference between these two spaces: in other words, that the arm of a paddle wheel is to be judged of precisely in the same manner as the arm of a locomotive driving wheel.

For the Journal of the Franklin Institute.

On the Comparative Value of Anthracite and Bituminous Coals for the purpose of Generating Steam.

Congress has recently called on the Secretary of the Navy for the report of the Engineer in Chief, Charles B. Stuart, Esq., on the comparative value of the two different kinds of coal for the purpose of generating steam. Some years since a large number of experiments were made by Professor Walter R. Johnson, from samples of coal furnished by miners, all of which were published by authority of Congress; and in consequence of the result of those experiments, the naval steamers have been supplied with Cumberland coal, very much to their injury and expense.

The only true test of the comparative value of coal is to take the two kinds as they are delivered at your ship, stowed in the bunkers, and brought out at your boilers ready for use. The anthracite will undergo all this without change, while the Cumberland, from its friable nature, becomes reduced almost to a powder.

The experiments of Mr. Stuart are from two lots of coal delivered at the New York Navy Yard, and the contents of the large stone dock at that station have been several times pumped out with each kind. The result has not yet been made public, but it is understood that the anthracite is about 50 per cent. cheaper than the bituminous, the difference in cost of each per ton being considered.

Many of our naval engineers have for several years past been strongly in favor of anthracite coal, owing to the very great trouble of getting any Cumberland suitable for steaming. The steamer *Fulton* is fitted for anthracite; the *Saranac* recently took in 150 tons of it at San Juan de Nicaragua, and her engineer prefers it to bituminous; the *Mississippi* now has 300 tons in her bunkers, for her next cruise; and, in fact, the general feeling is in its favor, and this feeling is in a great measure caused by the want of mechanical strength in the Cumberland coal, to withstand the necessary handling before it reaches the furnaces. In this respect the Cumberland is inferior to most coals of that class, particularly the English. The *City of Glasgow* burns Cardiff coal on her trips to this port, and is enabled without difficulty to carry a fair pressure of steam. On her return, she burns Cumberland, and cannot make steam sufficient even with an increased supply of fuel.

In addition to the economic value of anthracite coal, it is entirely free from all danger of spontaneous combustion. B.

For the Journal of the Franklin Institute.

On Ericsson's Caloric Engine.

Messrs. Hogg & Delamater, of New York, are constructing for and under the superintendence of Captain Ericsson, a pair of very large caloric engines, intended for a vessel of about 1900 tons, and every possible exertion is being made to have her ready for sea in September. It is not my purpose to discuss the merits of this engine at the present time, deeming it sufficient to say, that after many years of active exertions, Captain E. has at last perfected to his own satisfaction and that of his friends, his caloric engine. It has been fully secured by patent in this country and in Europe. A model engine of 60 horse power has been in operation at the works of Messrs. H. & D. for months past, and it has been repeatedly tested to their entire satisfaction.

The machinery for this vessel will be a pair of engines, one abaft the other, in line with the keel of the ship. Each engine has two cylinders (single acting) of the diameter of 14 feet, with 6 feet length of stroke. To each engine there is one beam, and the connecting rods from both engines take hold of the same crank-pin, but from the position of the engines, both are not on the centre at the same time. There are two air pumps to each engine, for forcing the proper quantity of air into the receiver; their diameter is 137½ inches, and stroke same as that of the cylinders, directly over which they are secured. The pistons of the two are connected together by several rods, and it is from the lower side of the air pump piston that the power is communicated through the beams to

the cranks, on the shafts of which are side wheels, about 32 feet diameter, and 8 feet face.

Should the practical operation of this ship prove successful, 100 tons of coal is expected to do the work of 1000 tons in the steam engine, and the advantages that would accrue to the world cannot be estimated.

For particulars of the patent, see *Journ. Frankl. Inst. vol.* xxii. 228.

B.

For the Journal of the Franklin Institute.

Notice of the Naval Dry Dock and Railway at Philadelphia.

The United States Dry Dock at this port having recently been completed, was successfully tested during the past month by the lifting and hauling out of the steam ship *City of Pittsburg*, of 2200 tons burthen. This Dock and appendages being the largest in the world, merits more than a passing notice. The lifting power consists of nine sections, six of which are 105 feet long inside, and 148 feet over all, by 32 feet wide, and 11½ feet deep; three of them are of the same length and depth as the others, but 2 feet less in width; the gross displacement of the nine sections is 10·037 tons, gross weight 4145 tons, leaving a lifting power of 5892 tons, which far exceeds the weight of any vessel yet contemplated. The machinery for pumping out the sections consists of two engines of 20, and two of 12 horse power. In connexion with the sections (which form the lifting power of the dock,) is a large stone basin, 350 feet long, 226 feet wide, and 12 feet 9 inches deep, with a depth of water of 10 feet 9 inches at mean high tide.

At the head of this basin are two sets of ways, each being 350 feet long, and 26 feet wide. These ways are level, and consist of the bed pieces, which are three in number, and firmly secured to a stone foundation; the central way supports the keel, while the side ways receive the weight of the bilge; these ways are of oak, and are finished off to a smooth surface. On the top of the bed pieces or fixed ways, comes the sliding ways or cradle, which are also 350 feet long and 26 feet wide, so constructed as to admit of being adjusted to the length of any vessel.

The operation of the dock is as follows:—The sections are sunk so as to allow the vessel to be floated in; as soon as she is secured in the proper position, the pumps are put in operation, when the sections begin to rise, and as soon as they come to a bearing on the keel, the bilge blocks are run in until they fit the ship. When all is secure, the sections are pumped out until the keel is some two or three feet above the water. If repairs that will only require a short time are contemplated, the vessel is kept on the sections, and no other portions of the dock used. But the *Pittsburg* was taken up for the purpose of testing the several parts of the dock, and after she was lifted out of the water the sections carrying the ship were floated into the basin in line with one of the sets of ways. When this is accomplished, the sections are filled with water, and rest on the bottom of the basin, which is of stone. Bed ways are now laid on the sections in line with those before mentioned. When they are secured they are greased, and the cradle is now slid under the ship, and she is

blocked up on the cradle, and the blocks on the sections are removed. At this point of the operation a new instrument of power is brought forward for the purpose of hauling the ship from the sections on to the bed ways in the Navy Yard. It consists of a large hydraulic cylinder, having a ram of 15 inches diameter and 8 feet stroke, and a power of 800 tons. On the top of this cylinder, and attached to it, are two vertical direct acting engines, with cylinders 16 inches in diameter and 16 inches stroke, connected at right angles to one shaft, on which are four eccentrics for working four hydraulic pumps of 1½ inches bore, and 6 inches stroke; the tank which carries the water for the press is also on the top of the cylinder, and forms the bed on which the pumps are secured. The boiler which supplies these engines with steam, is on a sliding cast iron bed way, some 12 or 15 feet ahead of the hydraulic cylinder, and connected to it by two cast iron rods. This boiler is of the usual locomotive form, and has 85 tubes of 2 inches diameter, and 9 feet long. To get ready for operation, the hydraulic cylinder is slid down to the edge of the basin, its ram is run in, and a connexion made by means of two side rods of wrought iron from the cross head of the ram to the sliding cradle which carries the ship. The central bed way has key holes mortised through it horizontally, every 8 feet, and there are projections from the hydraulic cylinder, which have corresponding key holes in them. Two cast iron keys, 24 inches wide, and 6 inches thick, are slid through the key holes on small wheels; these keys secure the cylinder to the central bed way; the engines and pumps being now put in operation, a pressure is brought on the 15 inch ram, and as soon as the pressure overcomes the resistance, the vessel must move. The estimated weight of the *Pittsburg* was 2800 tons, exclusive of the sliding ways and blocking; the power required to start this weight on a level, greased surface, was 250 tons. As soon as the vessel has been moved 8 feet, the keys which hold the cylinder to the central way are withdrawn, and by means of a screw which is attached to the head block of the ram, and driven from the engine, the cylinder and boiler are in their turn rapidly slid ahead, (the water in the cylinder being allowed to escape into the tank,) when the cast iron keys are again slid in place, and the vessel moved another 8 feet. After the first starting of the *Pittsburg*, the power required to remove her was but 150 tons, and she was moved 260 feet in 6 hours. To push the vessel off, the cylinder and appendages are moved to the head of the ways, put on a turn-table and reversed, when it is again brought down to the cradle, and the cylinder being secured as before, the head of the ram is applied directly to the cradle, and the vessel shoved back on to the sections, which requires the same time and power as to haul them off. In docking and hauling out the *Pittsburg*, every part of the work gave the most entire satisfaction, no portion showing the least defect, and the time required to go through the various operations being less than was expected. But six sections were used for lifting in this operation, leaving three unemployed. It will at once be seen that the capacity of this dock exceeds that of the stone docks at New York, Boston, and Norfolk, combined, for united they can take but three vessels, while here, two of our longest war steamers may be hauled out on the ways, and two frigates lifted on the sections. The advantages that

must result from the facilities of repairing a vessel elevated into light and air over one sunk in a stone dock, are very great, and have only to be seen to be appreciated. I am indebted to the work on Naval Dry Docks, recently published by Chas. B. Stuart, Esq., Engineer in Chief, United States Navy, for many of the details of this article. B.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, May 20, 1852.

Thomas Fletcher, Vice President, in the chair.

Owen Evans, Recording Secretary, *Pro. Tem.*

The minutes of the last meeting were read and approved.

Letters were read from A. Vattemare, Esq., Paris, France; The Zoological Society, London; and Prof. A. D. Bache, Coast Survey, Washington City, D. C.

Donations were received from The Minister of the Interior, Agriculture, and Commerce, of France; The Zoological Society, and The Chemical Society, of London; Prof. A. D. Bache, Coast Survey, and The Smithsonian Institute, Washington City, D. C.; Hon. Joseph R. Chandler, S. G. Haven, and John Robbins, Jr., Members of Congress; Charles B. Stuart, Esq., Engineer in Chief, U. S. Navy; John P. Whipple, Esq., Engineer, U. S. Navy; William J. Lewis, Esq., San Jose, California; Dr. T. S. Kirkbride, Seth Craig, Esq., Dr. L. Turnbull, and Dr. C. M. Wetherill, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of April.

The Board of Managers and Standing Committees reported their minutes.

The Special Committee on the Law for the Ventilation of Buildings, presented their report, and were discharged.

New candidates for membership in the Institute (6) were proposed, and the candidates (6) proposed at the last meeting were duly elected.

Dr. Rand exhibited some further specimens of Hyalotypes, taken by the Collodion process, by Dr. C. M. Cresson, to which he had called the attention of the members at the last meeting. By the addition of bromine the sensibility of the film had been much increased. The pictures exhibited were taken in from six to thirty-two seconds in diffused light, in one-quarter and one-half seconds in the open air.

Dr. Wetherill brought forward a piece of water pipe which had been buried and in constant use in this city for 24 years, and showed but a slight incrustation of oxide. He had found the coating, on analysis, to consist of a mixture of protoxide and sesquioxide of iron, with traces of silica, carbonate of lime, and magnesia, and fourteen per cent. of volatile matter.

Mr. Graff remarked that in certain cases in Boston and New York, the oxidation of the pipes was very rapid, while with us it was usually slow. Some discussion arose on the causes of this discrepancy, and the mode of protecting the pipes.

Dr. Turnbull exhibited a map of the telegraphic lines in the United States, and gave a history of the progress of telegraphic communication in this country.

Dr. Rand further exhibited a drawing, which he had received from Mr. Bartol, of the fracture of the centre shaft of the Steamer *Hermann*. The shaft broke square off between the crank and journal. That portion which is white in the annexed cut is the part of the shaft that was solid at the time of the fracture; the black portion was very much discolored by oil and dirt, and had evidently been cracked for some time.

Mr. Henry Francis presented a specimen of glazed sheet iron ware. Mr. Francis remarked that he was about to commence the manufacture of this ware on a large scale in this city.

Mr. J. V. Merrick exhibited a specimen of the new wrought iron tube for external pressure, manufactured by Thomas Prosser & Sons, in New York. This tube is joined mechanically and without brazing or welding, dependence being had for tightness under pressure on the previous preparation of the edges. It was stated that this tube had been applied in several boilers in England, and recently in New York, giving satisfactory results. The advantages claimed for it were the increased strength and diminished probability of corrosion, owing to the preservation of the *surfaces* of the original boiler plate from which the tubes were made, which, in the old plan, are abraded by passing through dies.

He also called the attention of members to specimens of compressed fuel, supposed to be a conglomeration of powdered bituminous coal, tar, and clay, which had been brought from England by the Steamer *City of Glasgow*, and still retained nearly its original form after passing through the coal bunks.

BIBLIOGRAPHICAL NOTICES.

Memorial of ALFRED GUTHRIE, *a Practical Engineer, submitting the Results of an Investigation made by him into the Causes of the Explosion of Steam Boilers.*

To a person who has not made himself practically familiar with the steam engine and its applications, it must appear very singular, that there is such an irreconcilable diversity of opinions set forth by writers on the subject, not only as to the best method of using this power, but particularly as to the dangers accruing in its use, and the best modes of avoiding these risks. Especially would it appear strange to one, familiar with the study of science, that in a matter so exclusively physical, recourse should be had so continually to the most mysterious agencies, to account for the terrific explosions with which almost every electric wave from the west comes loaded. The reason for these anomalies is, however, easily to be found by the searcher, in the rapid advance of the use of steam power in our country, which has so far outrun the power of our

population to supply it, especially in the West, where labor is in such demand, and the competition in business is so great, that the place of engineer in charge of a steamboat, including as it does, the responsibility for the lives of hundreds of passengers at a time, is frequently, indeed most frequently intrusted to persons, who are in no wise fitted either by previous education, or by mental or moral habits, to be entrusted with such responsibilities.

When under such inefficient administration, the proper precautions are neglected, and an explosion ensues, it becomes necessary to find some explanation for the phenomena, which shall not point to a fault, on the part either of the builders of the engine and boat, the owners, captain, engineer, sub-engineer or hands; and so electricity, the spheroidal state, magnetic repulsion, are taxed beyond their powers, and each novelty in science is necessarily grasped at to account for these fearful phenomena, to the investigation of which, according to the laws of common sense, no law of the United States, nor any officer of state or county is competent.

Many years ago, at the request of the U. S. Government, the Franklin Institute appointed a committee to investigate the causes of explosion of steam boilers, and the means of preventing such accidents, which committee made a report which has become classical in this branch. Since that, we have had nothing on our side of the Atlantic sustaining the principal and satisfactory views here expressed, until the memorial to Congress, whose title stands at the head of our article. Here, however, we have the production of a practical steam engineer of Chicago, who has devoted a considerable portion of time to the investigation of this very interesting matter, and whose results are precisely in accordance with those before arrived at by Messrs. Bache, Reeves, and others of the Franklin Institute committee. Mr. Guthrie in his very able pamphlet, handles the subject in an entirely practical way, and rejecting all mysterious agencies, attributes the explosion of the steam boilers of our Western boats—First, to the faulty materials or faulty construction of boilers; secondly, to badly arranged relations between the power of the engines and the resistance of the boats; thirdly, to the neglect of those in charge, either in permitting the elastic force of the steam to increase beyond the cohesive resistance of the boiler, or in permitting the water to become low, and thus to present a heated surface of metal, which, under certain circumstances, is necessarily followed by a tension of steam which no boiler shell can withstand. This branch of the subject is of such importance that we shall make no excuse for presenting to our readers a portion of Mr Guthrie's remarks and illustrations of the subject, which we do the more gladly, as they will well express our own views on this subject, in opposition (practically) to the remarks on this subject by an esteemed correspondent in the present number of the Journal, page 413.

"Explosions produced through the *gradual increase* of steam within the boiler, probably, are not of as frequent occurrence as from other causes; yet, explosions have undoubtedly occurred from this alone, and as yet nothing has been introduced to prevent the same occurrences from the same cause. By far the greater proportion of explosions are produced by a *sudden* increase of steam beyond the ability of the safety-valve to relieve, or the powers of the boilers to resist, and almost always occur-

ring within a minute or two after starting the engine. These facts are well known to all who have in any manner inquired into these subjects; they are so well known as to require no proof in confirmation of them.

"In order more fully to explain the cause of this, I must refer to plate 2. Fig. 2 represents a boiler in which the water has become low, no matter from what cause. It will be seen that the top of the flues have become uncovered, and the water receded down to the middle of the flue; the boat is supposed to be lying at her landing, with steam up ready to start; the fire passes along on the under side of the boiler, and returns through the flues. As shown in plate 4, it will be apparent to any one that the flues will be heated on the top just in proportion to the intensity of the flame urged through them; the sides of the boiler above the water line will also be heated in like manner, as far up as it is allowed to reach. Supposing this to be continued until all these parts are at a red heat, so long as there is no escape of steam from the safety-valve, or to the engine, the surface of the water remains nearly smooth, apparently unagitated; but the instant an escape is opened from any cause, the water is set in violent commotion, forming air or steam bubbles and froth, with a tendency always to follow the discharge of the steam overcoming these heated surfaces, and augmenting rapidly the volume of steam in the boiler, falling short of or exceeding its powers of resistance, as may be.

"It is the case frequently, when water is low, that it can be found in the gauge-cock, simply by surging or lifting the safety-valve, in consequence of the tendency of the water and steam to rush towards the discharging point.

"I will now suppose a steamboat as lying at her landing, water low in the boilers, the flues uncovered, and heated to a red heat; the steam has been prevented from escape, and gradually increased in density until it is at or near the exploding point—perhaps designedly by the engineer, for the most reprehensible design of making a great display on leaving the port. It is often that this condition of things is produced by the engineer, for no other motive than that of passing up and down before a town merely in wanton display, and sheering close along the shore, in order to augment the swell and attract attention. It should be remembered, that although this "may be sport" to the engineer, it may terminate in something worse to the passengers. However, we will suppose this state of things is existing. Now, if the engine should be started, the boat careened, or, by any casualty, water should be thrown upon these heated surfaces, it is as plain as that two and two make four, that steam will be generated; and if that should be more rapidly than the safety-valve can discharge, an *explosion must follow*, unless the boilers are strong enough to confine it.

"Hundreds of instances have occurred where this state of things has not been long enough continued, to heat a sufficient amount of surface for generating steam beyond what the boiler could resist, or where there was not a sufficient quantity of water thrown at a time upon these heated plates to make enough steam to overcome the powers of resistance of the boiler, but where, most assuredly, an explosion would have followed with but a slight addition of either. All these occurrences tend to weaken the powers of the boilers, and perhaps upon the next occasion they

might yield to a less pressure than that which they had actually resisted before. It will be recollected that these things are passing upon the inside of the boilers, and of course unknown and unseen by the passengers, although the engineer may be well enough apprized of the facts after they have occurred; but it is evidently his interest to conceal them; and as no benefit to him could be derived by its exposition, it need not be expected *he* would do it, but rather content himself by "thanking his stars" that the boilers had withstood the terrible shock.

"As these things are carried on in the dark, we are to look at them in the most rational and common sense manner we can, divest them of all witchcraft or necromancy, treating the subject as we would all others similarly situated, that we may then hope to arrive at safe and proper conclusions as to the causes, and the means best calculated to prevent them.

"It is by introducing and explaining all the facts I can gather, connected in any way with this subject, I hope to convince those who may give me a candid perusal, that there is no *valid excuse* for an explosion of a steam boiler.

"I trust from what has now been said, that it would be a rational conclusion, that if we allow the water to get low in a boiler, the flues to become uncovered, and the fire continued, the flue will become heated upon the upper side, and of course weakened, and as ready to yield to the *pressure* of steam as to the effect of a sledge hammer effectually applied. At the same time it has stowed away within itself a heat which it will certainly give back upon the first application of water; and the larger the amount of heat to be given out, or, in other words, the greater the surface heated, (with a sufficient application of water,) the more dreadful will be the consequences. It is found by actual experiment, that a single cubic foot of iron heated to a red heat, is capable of generating steam enough to fill the largest Mississippi boiler, with a pressure of over five hundred pounds per square inch.

"There is, after all the advantages from the powers of these boilers to resist intense pressures, a serious objection to their use; the flues occupy so large a space of the internal portion of them, that it is difficult to keep over the flue a proper head of water, affording the engineer but little "leeway" in case of accident or want of care, a slight inclination of the boat, from the changing position of the passengers or freight, throwing a bare flue upon the highest side. This is a serious objection; but this kind of boiler has become so generally adopted as the best form for the Western waters, that it will probably remain as it now is; at least, I know of no other form at all likely to supersede it.

"There are instances where water was allowed to get low, and where an explosion (as it were by a miracle) did not occur.

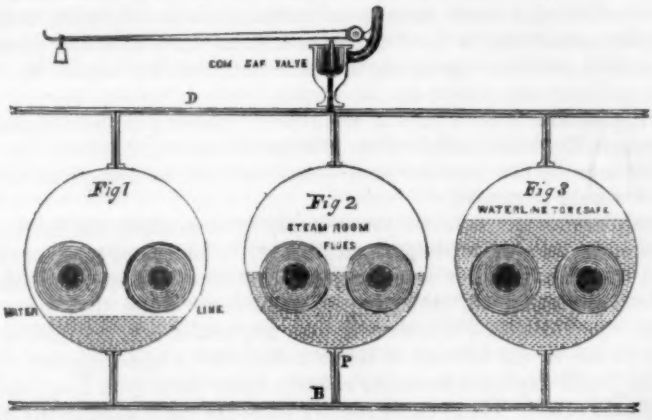
"One instance, authenticated beyond all question, I will here relate. In a steamboat running to the port of Chicago, on a perfectly still day, the water was allowed to get low by some obstruction of the forcing pump, and continued to decrease until every particle of the flues was uncovered; and only seven inches of water on the bottom of the boiler. The flues became heated to a perfectly red heat, and of course the steam, which was generated below them, in coming in contact was heated to a like heat, and in passing through the pipes, set fire to the covering which

surrounded them; even the solder with which they were united, melted and ran off like water.

"For an instant conceive the terrible consequences which would inevitably have followed, had water been suddenly applied to these red hot plates! In this instance, as soon as this state of things was known to exist, the fire was immediately drawn out, and everything cooled down as rapidly as possible; whilst the boat was kept perfectly quiet, and the safety valve not allowed to discharge any steam. As soon as the boilers had been cooled down to a safe point, the forcing pump was examined, and the difficulty corrected, when the boilers were filled up and the boat proceeded on her way."

As to the causes of this condition of things, we know no one who has as yet presented them as clearly and practically as the author before us.

"*What are the Causes of Low Water?*—In the examination of this branch of my subject, I shall find it necessary to take rather a wide scope; for, there are so many causes operating, and "*low water*" has such an important influence in producing the sad consequences more or less attendant upon all steam boiler explosions, that I must necessarily occupy a large space of this treatise in giving a clear understanding of them.



"Plate 2, showing the present Mississippi boilers with what I consider too contracted passages for water and steam; should be increased from 9 inches area say to 27 inches; the pipes changed from cast to wrought iron by all means.

"I have made the drawings, plate 2, figs. 1, 2, and 3. These represent an average number of boilers supposed to be used on each boat now navigating the western waters; these boilers are shown as standing upon and supported by what is termed the "stand-pipe," through which the water is supplied to the boilers; a very great proportion of these are made of *cast* iron, the opening for the passage of the water being only from 2½ to 3 inches in diameter; in many instances the opening does not exceed 2 inches. The stand-pipe marked B, is here purposely represented to show a very small opening, through which it is apparent that all the water must be conveyed to the boiler. Now it is a singular fact, and one, perhaps, which is not generally known, that *cold* water will hold in suspension a

greater proportion of lime than warm or hot; hence, when the temperature of the water is increased, as is generally the case in the heater, before it is sent to the boilers, the lime will be deposited first along the pipe leading to the boiler, and form there a very hard incrustation or deposite, which is very difficult to remove; this deposite will be continued as long as lime is held in suspension in the water by which the boiler is supplied. Oftentimes, in unfavorable localities, these openings will become entirely closed, and the water will of course be entirely cut off. It is this lime held in suspension which gives to water its characteristic which we denominate "hard water;" most all water contains more or less of it.

"I will raise the supposition, that the greatest amount of this deposite does not occur until after the water has passed the second boiler: it will be apparent, as this obstruction is increased, the greater will be the difficulty of water passing to the third boiler than to the second, and so on. Now if water does not readily find its way to the third boiler, of course it will be found *low* there, and probably *high* in one or both the others—showing "*good water*" in these, when in fact it is low in the third. The consequence is, the flue becomes bare and heated, and at the same time weakened, until it is sunk in by the pressure and depressed below the water—producing a rapid increase of steam, and an explosion follows; the engineer asserting, in the most solemn manner, that he had plenty of water, which may be true as regards one and two, but not of the third one.

"It may be that water so full of sediment as is found in the Mississippi, in passing to the boiler, might close this small opening as effectually as it could be done by the incrustation of lime—perhaps by a union of the two causes it would hasten it.

"Instances may occur where persons employed to clean out the boilers have taken in with them an old scrub-broom, a bundle of rags, packing, or some other material for sweeping out the mud and accumulation of sand, and forgetting or neglecting to remove it when they have got through. Suppose this, whatever it may be, settles into and fills up the passage to one of the boilers, or forms a nucleus for checking the dirt in the water, until finally it becomes closed; water then gets low, and the usual effects result. The remedy readily presents itself: *enlarge* the opening of the stand-pipe; and they should always be made of *wrought* iron, and never without an opening of six to eight or ten inches in diameter. There is no possible objection to it. Although explosions may not be brought about very frequently from these causes, yet there are undoubtedly instances where they alone have been the cause, and may do it again. Certainly, prudence alone would dictate an enlargement to guard against it.

"It may be urged that the stage of water in the boiler here described, would be indicated by the "try-cocks" in them. This is very true—it *might* be; but, in many of the boats some of the boilers have no gauge-cocks at all. Besides, an engineer might entirely neglect some one or more of the boilers, if they were furnished with them, and he was constant in his attention to the others; relying upon the hope that if water was good in one, it would be in all. I have, since I commenced the exami-

nation of this subject, passed from Cincinnati to St. Louis on a steamboat where the engineer did not in the whole passage test the water in one of the boilers; I knew the fact by putting upon the stem of the try-cock a little mud, which must have been broken off if it had been tried.

"Although this was a middle boiler, still it should never be neglected, as an obstruction might occur at the upright part marked P, and water pass freely to the last boiler.

"Another cause of want of water, is the inability of the forcing pump to supply, from its want of capacity. If a pump should be found entirely too small to supply the boilers, it would of necessity be laid aside; but in a case where the capacity was just about equal to the demand, or even a little more, when all the valves were in perfect order and working all the time, it would probably be retained, and an effort made to get along with it rather than encounter the additional expense of a new one. Now suppose, for a moment, a pump of this kind, with an engineer of the most undoubted capacity, and noted for his care and prudence, starting his engine with good water in his boilers, and should in a little time find his water going down a very little; he might examine his pump, and remove what he considered the obstruction; he has no means of knowing, without a further trial of his pump, whether it is corrected or not, the pump being hardly sufficient to supply the demand without increasing it; he trusts it in a state of doubt and uncertainty, until it is finally lost in the lower cock. He knows nothing now where the water is, but he knows it is not prudent to go any further; yet, as all on board are anxious to get through, he makes another examination of the pump, and finds a small stick or piece of rag that allowed the water to leak back. The pump is now corrected, and at this moment they run upon a sand bar, or the boat is stopped to take on a passenger. During this time, and no matter how short, the water settles away still lower, and the flues are heating rapidly, until the bell rings to start the engine. Apprehending the dreadful consequences, the engineer complies with the order; the water is set in agitation, overflows the heated flue, a sudden increase of steam is the result, and a struggle between the steam and the boiler follows; the boiler is found the weaker, and gives way: the consequences are too familiar to need a repetition. To make this still more plain, a pump is shown in plate 8, with the obstruction under the valve; and a very small one will answer to produce all the results described.

"The remedy suggested would first be to enlarge the capacity of the pump to double the demand for water in the boiler, and never to run a boat without two of them, that the supply may be continued even though a slight obstruction might occur.

"A great and important remedy is already introduced upon many of the boats, known by the familiar term of "doctor." This is a separate engine connected with the pumps alone, for supplying the water independent of the large engines.

"I conceive this so important an appendage to the safety of steamboats against explosions, that no boat, in my opinion, should be allowed to run a day without one. The value of these engines is now well understood, and they will be likely to be adopted on all new-built boats, whilst the old ones may strive to keep along without them.

"It is well known, however, that steamboats are blown up even when supplied with the best of doctors and the most perfect arrangement of pumps, and some further remedy is required to correct any difficulty that may exist with them.

"I will suppose another case, in which, with a suitable arrangement of pumps, and with the most trustworthy engineer, water may get low, and an explosion occur where it might appear as if the engineer had really been faithful and was not much to blame.

"I will suppose plenty of forcing pumps and a moderate stage of water, the boat running along prudently, the engineer relying upon the known capacity of his pumps to fill up the boilers as rapidly as he may desire; the captain neglects to inform him that he is about to make a landing, but the bell is suddenly rung to stop. Now, it is well known that water will be lost very rapidly when the engine and all are lying still. It wastes away, notwithstanding every thing seems to be perfectly tight and sound. When the boat stopped there was a safe supply, but it begins to diminish; and on inquiry, the captain informs him that he will not be detained but a moment. There is no doctor or any pumps to supply the boiler, that can be worked by hand, and the boat lies in such a position that the large engines cannot well be started; he holds on; water is lost in the lower cock; he begins to feel much alarm, but he expects every instant that the order will come to start, and the deficiency may be made up; during this time the flues become bare and heated, and the dangers of an explosion follow. Had the captain informed him in time, he would have pumped up an additional head before landing, which his pumps would have enabled him to have done.

"These are a few among many instances that may and do often occur, where an engineer may be perfectly competent and careful in the discharge of his duties. Nevertheless, whilst all these dangers are accumulating, the passengers are unapprized of the volcano that slumbers beneath.

"Again, water may get low from *inattention* of the engineer. Supposing he may have a pump with the most ample capacity; it can hardly be expected that water can be fed to the forcing pump so equally, as exactly to meet the supply required by the boilers without any alteration. When the engine is started, we suppose the engineer to go and let on such a supply as he may think is necessary; he waits a little time, and tries the gauge-cocks, and finds he has rather too much water; he diminishes the supply a little, and sits down to await the result; in a short time he tests the water again, and finds, perhaps, that he shut off a little too much; he again adjusts it, and relaxes his vigilance. Perhaps he has been up through the night—is worn out with watching; he sits down and neglects to examine for some time; he feels "*pretty sure*" that the water is being supplied *very near* right, and it is a task to try it so often, and it is deferred until he makes up his mind that it will not do to *risk* it any longer; when, on examination, he finds, to his surprise, that water is gone in the lower cock; he hastens to the supply and turns on all the water, but during all this time a chip has found its way under the valve, or some difficulty has occurred, and instead of getting up rapidly, as he expects, it continues to decrease, and at this juncture the boat makes a landing; and now the

water has a still further decrease by the discontinuance of the agitation, the pump is stopped, and consequences must follow the stage of water within.

"It is undoubtedly the case that, in such instances, the only *safe* course to be adopted is to put down the fires, reduce the temperature and pressure as much as possible, and then fill up with water before running any hazard, and such a course as prudent engineers will adopt; but the question is, will *all* engineers adopt it, knowing it to be so?—evidences are too much against it to indulge the hope.

"Again, instances of the *recklessness* on the part of the engineer, and perhaps other officers of the boat, may be with propriety introduced here. The following, however, may convey enough to show how it may occur, and the passengers, whose safety and lives may be endangered, have no possibility of avoiding it.

"I will suppose a strife between two steamboats: one is attemptingt o pass the other. The excitement is increased to its highest pitch. The fires are urged to their utmost; the firemen are stimulated to increased exertion. The engineer, too, lends his aid to increase the intensity of the heat; he finds he is increasing his steam, and it begins to escape from the safety-valve; he then loads it with additional weights in the shape of wrenches, hammers, or anything that comes to hand, without knowing, or perhaps caring much, what effect they will have in increasing the pressure of steam. The same things are passing upon the other boat; it is determined "to pass or blow her up;" the forward boat finds that with all the firing that can be done, the other is likely to pass; the engineer goes to the water-gauge, and perhaps finds, thus far, he has kept up a good stage of water. He is in hopes that the other boat will not continue the race but a short distance, or that it is but a short distance when both can part; and if he can by any means hold out until this occurs, he can then unobserved put himself in a safe position. After looking it all over, he concludes he can stand it without *feeding any more water:* at all events, *safe or not safe*, "that boat shall never pass him alive." The other boat has anticipated this movement, and has shut off her water beforehand. This is not altogether a supposed case, but one that has often occurred, and may often occur again.

"The passengers may very justly become alarmed, or, for all that, partake in the excitement; but it cannot be supposed they are made acquainted with the condition of things below; or, if they were, it does not remove a tittle of the danger."

The inefficacy of the "mysterious explanations" is also ably shown, but we have at present no room to extract these remarks.

In reference to the excessive pressure, he remarks that the ascertained pressures vary from 140 to 200 pounds per square inch, but that in many cases there is no means of knowing either, by the engineer himself, what pressure is carried. These statements are still more startling when by reference to a calculation made by Mr. Merrick, jr., in the May number of our *Journal*, page 344, it is shewn from data, sworn to by the builders and engineers of the Western boats themselves, and for other purposes, that owing to the errors in the construction of their engines, in reference to their steam-ports and valves, scarcely more than one-half of this pressure is avail-

able in the cylinders—thus showing how the lives of the passengers are frequently risked without even the poor satisfaction of such pressures being necessary for the desired speed.

We shall probably in a future number, call the attention of our readers again to the extracts from this able pamphlet in reference to the manner in which engines and boats are built and run in the Western waters; for the present, we conclude with the simple remark, that, as was to be expected, this pamphlet, so clearly setting forth the fearful disregard to the safety of life on our waters, appears to have attracted no attention from Congress, and that it seems that we must look for a remedy, not from the laws of the Union or the State, (for the Institute has in vain urged on our Legislature, the necessity of legislating in reference to stationary boilers in our State,) but from some new contrivance, such as the Ericsson engine now in course of construction in New York appears to be.

F.

The Naval Dry Docks of the United States. By CHARLES B. STUART, ESQ., Engineer in Chief, U. S. Navy. Published by Charles B. Norton, Irving House, New York.

No American work on Engineering has been issued from the press, that will compare with this work in the beauty of its execution, or the intrinsic value of its contents. While the English press has issued book after book, until there is hardly a subject that has not been fully explained, or a public work that has not been illustrated, we have been quietly purchasing their publications, being satisfied that it would not pay to attempt any thing of the kind in this country. This is certainly a melancholy fact, if true. When we reflect that in railroads, water works, gas works, steam ships, sailing ships, dry docks, and bridges, we have works of greater magnitude, built at much less cost, it does appear hard that books fully descriptive of such works, illustrated in a manner commensurate with their importance, cannot be made to pay sufficiently well to justify the expense. This has been the opinion of the past. Mr. Stuart thinks *that time* has gone by, and having been engaged for several years on the stone Dry Dock at New York, the Sectional Docks of Philadelphia and California, and the Balance Docks of Portsmouth and Pensacola, he has concluded to publish a part of his labors, and hence the present work. It is illustrated with twenty-four engravings on steel, made to an accurate scale, so that if measured, each dimension will be found to agree with the description. Every engineer will appreciate the value of such drawings, for, unfortunately, the engravings of many publications in this country and Europe, if judged by this standard, will be found mere pictures. The work also contains the history of each dock, the nature of its foundation, the quantity and kind of material used, the time and cost of its construction, the names of the engineers and contractors, and a great deal of valuable information to those at all interested in the public works of the nation. We trust that Mr. Stuart has not over-estimated the amount of support that his book will receive in this country, and we hope the American people will come forward in a liberal spirit, and sustain a publication so creditable to the country.

B.

INDEX.

LIST OF AMERICAN PATENTS, WITH REMARKS, &c.

November, 1851.		Page.
21. Improvement in Cheese, Butter, & Bread Cutter,	Benjamin F. Adams,	13
22. —— Scythe Fastenings,	David Anthony, Sr.,	14
23. —— Hand Planes,	Benjamin F. Bee,	ib.
24. —— Winnowing Machines,	Jonathan Bean,	ib.
25. —— Stave Jointing Machines,	Daniel Drawbaugh,	ib.
26. —— Shuttle Motions,	George W. Perry,	ib.
27. —— Cutting Soles of Boots, &c.,	J. Steger, assignor to W. Mitchell,	ib.
28. —— Car Seats,	Ezekiel Booth and Azra Ripley,	15
29. —— Telescopes,	Alvan Clark,	ib.
30. —— Cutting Hides,	Jacob C. Flint,	ib.
31. —— Bending Felloes,	Andrew W. Johnson,	ib.
32. —— Card Grinders,	Richard Kitson,	ib.
33. —— Daguerreotype Apparatus,	W., W. H. & J. Lewis,	ib.
34. —— Coupling Railroad Cars,	Lorenzo D. Livermore,	ib.
35. —— Abdominal Supporters,	Allen J. Lonsbury,	16
36. —— Bedsteads,	Levi Newcomb, Jr.,	ib.
37. —— Horse Collars,	Richard Rickey,	ib.
38. —— Grain Kilns,	Isaac S. Stover,	ib.
39. —— Frosting Plates of Glass,	Isaac Taylor,	ib.
40. —— Boot Trees,	Davis R. Hendrix,	ib.
41. —— Sizing and Dying Yarns,	Alonzo Bascom,	17
42. —— Printing Presses,	Thomas H. Dodge,	ib.
43. —— Cutting Combs,	S. Curtis,	ib.
44. —— Stove Grate Bars,	George W. Gardner,	ib.
45. —— Ploughs,	Henry Goldson,	ib.
46. —— Current Wheels,	James Hardie,	18
47. —— Railroad Car Wheels,	Nehemiah Hodge,	ib.
48. —— Grinding and Bolting,	Jehu Hollingsworth,	ib.
49. —— Throwing Chain Shot,	Adam Lemmer,	19
50. —— Screw Propeller,	Gaspard Malo,	ib.
51. —— Desks,	Isaac H. Norris and David Flanders,	ib.
52. —— Railroad Switch,	David F. Phillips,	ib.
53. —— Seed Planters,	William Redick,	20
54. —— Inserting Porcelain Teeth,	William Willshire,	ib.
55. —— Stoves,	Hale R. Rose,	ib.
56. —— Stove Grates,	H. J. Ruggles,	ib.
57. —— Spring Saddles,	John C. fr. Salomon,	ib.
58. —— Gongs,	Vine B. Starr,	ib.
59. —— Millstones,	George Todd,	21
60. —— Piles in Weaving,	Erastus B. Bigelow,	ib.
61. —— Fastenings for Garments,	Elias Howe, Jr.,	ib.
62. —— Cooking Stoves,	Hosea H. Huntly,	ib.
63. —— Cooking Stoves,	George W. Carleton,	ib.
64. —— Steam Boilers,	Jonathan and J. I. G. Collins,	ib.
65. —— Ploughs,	Elijah Goldthait,	22
66. —— Sugar Drainers,	Daniel King,	ib.
67. —— Operating Rudders,	T. H. Mortimer and J. Gardiner,	ib.
68. —— Door Knobs,	Orrin Newton,	ib.
69. —— Drop Presses,	Milo Peck,	23
70. —— Cider Mills,	David F. Phillips,	ib.
71. —— Shingle Machine,	Franklin Skinner,	ib.
72. —— Oscillating Engines,	William M. Smith,	ib.

73. Improvement in Railroad Car Brakes,	Francis A. Stevens, .	23
RE-ISSUE.		
1. Improvement in Screw Wrench, .	Solymon Merrick, . .	24
DESIGNS.		
1. For Stoves, . . .	J. W. Gibbs, assignor to North, Harrison & Chase, . .	24
2. — Iron Railings, . .	F. Fitzgerald, assi'd to Herring & Ryer,	ib.
3. — Parlor Stove Plates, . .	A. Richmond, assi'd to Barstow & Co.,	ib.
4. — Hat Stand, . .	Charles Muller, . .	ib.
5. — Parlor Stove, . .	Ripley & Vedder, ass'd to Low & Hicks,	ib.
December, 1851.		
1. Improvement in Looms for Bags, .	Cyrus Baldwin, . .	24
2. — Hand Drills, . .	William Bushnell, .	25
3. — Hurdle Fences, . .	Cyrus C. Cole, . .	ib.
4. — Paper for Soda Powders,	Carlos A. Cook, .	ib.
5. — Railway Switches, . .	William N. Raines, .	ib.
6. — Propelling and Steering,	John C. fr. Salomon, .	ib.
7. — Locks for Safes, . .	F. C. Coffin, assignor to C. J. Gayler,	ib.
8. — Railroad Car Trucks, .	Benjamin Hinkley, .	26
9. — Railway Steam Carriages, .	Joseph H. Moore and W. P. Parrott,	ib.
10. — Expanding Mandrels, .	Walter Sherrod, .	ib.
11. — Stretching and Drying Cloth,	Thomas Barrows, . .	27
12. — Papering Pins, .	Chauncy O. Crosby, .	ib.
13. — Working Clay, . .	Daniel and George Duchemin, .	ib.
14. — Tailors' Measures, .	James Maginnis, .	ib.
15. — Winding Watches, .	Theodore Noel, . .	ib.
16. — Carriage Perch, .	Lewis E. Stilwell, .	28
17. — Boring Holes in Posts, .	Thomas T. Strode, .	ib.
18. — Foundry Apparatus, .	Chapman Warner, .	ib.
19. — Gear of Locomotives, .	Ross Winans, . .	ib.
20. — Opening and Closing Gates,	Enoch Woolman, . .	29
21. — Reverberatory Furnaces, .	Ambrose S. Beadleston,	80
22. — Potato Diggers, .	Daniel D. Bell, .	81
23. — Musical Instruments, .	Cornelius Bogart, . .	ib.
24. — Carbonic Acid Gas Engine,	John C. fr. Salomon,	ib.
25. — Gas Regulators, . .	Jotham S. Conant, .	ib.
26. — Water Meters,	John Ericsson, .	ib.
27. — Lathe Chucks, . .	Jos. Hyde, assignor to Thos. J. Eddy,	82
28. — Feeding Logs in Saw Mills,	Charles Ketcham, .	ib.
29. — Washing Ores, Minerals, &c.,	Samuel Porter, . .	ib.
30. — Car Seats, . .	Ezra Ripley and E. L. Brundage,	ib.
31. — Lath Machines, . .	G. W. Tolhurst, . .	ib.
32. — Gear of Railroad Cars, .	Thomas A. Davies, .	83
33. — Chair Seats, . .	J. W. Drummond, assigned to S. Ely,	ib.
34. — Weavers' Temples, .	Elihu and Warren W. Dutcher,	ib.
35. — Organ and Piano, . .	Richard M. Ferris, .	ib.
36. — Carriages, . .	Gustavus L. Hausknecht,	ib.
37. — Making Kettles, &c., .	Hiram W. Hayden, .	84
38. — Adjusting Lenses, .	W. & W. H. Lewis, .	ib.
39. — Stethescopes, . .	Nathan B. Marsh, . .	ib.
40. — Artificial Jasper, .	John Paige Pepper, .	ib.
41. — Tumbler Locks, . .	D. H. Rickards and J. F. Flanders,	ib.
42. — Candlesticks, . .	Francis A. Rockwell, .	85
43. — Chimney Tops, . .	Charles W. Russell, .	ib.
44. — Churns, . .	Henry Skinner, .	ib.
45. — Shutter Operators, . .	Noah W. Spears, . .	ib.
46. — Pressing Garments, .	Joseph W. Thorp, .	ib.
47. — Smelting Copper Ores, .	Samuel F. Tracy, . .	86
48. — Tailors' Measures, .	Edward Virtue, .	ib.
49. — Grain Sieves, . .	Thomas B. Wheeler, .	ib.
50. — Pumps, . .	William Ball, .	ib.
51. — Chronometric Locks, .	William L. Bass, . .	ib.
52. — Leather Tubes, .	N. Wyllys, ass'd to Collins & Wyllys,	ib.

53. Improvement in Swaging Machine,	Perry G. Gardiner,	87
54. —— Suspenders,	J. Hotchkiss, ass'd to the Hotchkiss & Merriman Manufacturing Co.,	ib.
55. —— Making Candles,	Willis Hurniston,	ib.
56. —— Æolian Attachments,	Gustavus W. Ingalls,	88
57. —— Carriages,	Lewis King,	ib.
58. —— Harness Saddles,	John McLain,	ib.
59. —— Hanging Window Sashes,	Samuel D. Nims,	ib.
60. —— Planing Machines,	J. M. Patton and W. F. Fergus,	ib.
61. —— Making Wrought Iron,	James Renton,	ib.
62. —— Setting up Ten Pins,	Thomas E. Shull,	89
63. —— Counting Screws and Pins,	Thomas J. Sloan,	ib.
64. —— Heading Bolts,	Nathan Starks,	ib.
65. —— Spinning Rope Yarns,	Richard Sands Tucker,	ib.
66. —— Dressing Stones,	William Wheeler,	90
67. —— Ruling Paper,	John Ames and George L. Wright,	ib.
68. —— Screws for Bedsteads,	Jacob Zimmer,	ib.
69. —— Setting Mineral Teeth,	John Allen,	ib.
RE-ISSUE.		
1. Improvement in Locks for Doors, &c.,	Robert Newell,	90
DESIGNS.		
1. For Stove Registers,	Stuart & Beesley, ass'd to W. P. Cresson,	91
2. —— Stoves,	J. D. Green, ass'd to Backus, Bacon & Co.	ib.
3. —— do.,	W. Ames, ass'd to Hartshorn & Ames,	ib.
4. —— Frames for Presses, &c.,	Edwin L. Freeman,	ib.
January, 1852.		
1. Improvement in Ventilating Cars,	N. S. Barnum and L. Whitney,	91
2. —— Carriage Hubs,	Samuel S. Barry,	ib.
3. —— Constructing Bridges,	Wendell Bollman,	92
4. —— Covering Cheeses,	Upson Bushnell,	ib.
5. —— Carriage Curtain Locks,	George Cook,	ib.
6. —— Sheet Metal Disks,	J. F. Flanders, ass'd to Roys & Wilcox,	ib.
7. —— Clover Harvesters,	Mahlon Garrettson,	ib.
8. —— Steam and Water Gauges,	William C. Grimes,	ib.
9. —— Camphine Lamps,	R. V. DeGuinon,	93
10. —— Railroad Chair,	Peter P. R. Hayden,	ib.
11. —— Iron Railings,	Geo. Hess, ass'd to S. Shimer,	ib.
12. —— Daguerreotype Pictures,	Henry E. Insley,	ib.
13. —— Wool Picking,	Edward Kellogg,	ib.
14. —— Shovels,	Hiram Kimball,	ib.
15. —— Felting Cloths,	Jos. W. Lawrence, ass'd to S. Lawrence,	94
16. —— Fire Arms,	Richard S. Lawrence,	ib.
17. —— Straw Cutters,	Nathaniel Nuckolls,	ib.
18. —— Bleaching Ivory,	Ulysses Pratt,	ib.
19. —— Pen and Pencil Cases,	John W. Ranch,	ib.
20. —— Gold Pens,	Adam W. Rapp,	95
21. —— Gold Beater,	Ruggles & Serrell, ass'd to R. B. Ruggles,	ib.
22. —— Locomotive Trucks,	John L. White,	96
23. —— Cast Iron Car Wheels,	Horace W. Woodruff,	ib.
24. —— Ventilating Cars,	Henry M. Paine,	ib.
25. —— Scouring Knives and Forks,	Christopher Aumock,	163
26. —— Blind and Shutter Operator,	James R. Creighton,	ib.
27. —— Running Gear of Carriages,	Gustavus L. Haussknecht,	ib.
28. —— Cutting Piled Fabrics,	J. Johnson, ass'd to E. Johnson,	ib.
29. —— Lanterns,	Philos Blake,	164
30. —— Painting on Glass,	John W. Bowers,	ib.
31. —— Dressing Stones,	A. Eames, ass'd to C. T. Shelton,	ib.
32. —— Winnowing Machines,	Henry Filburn,	ib.
33. —— Iron Fences,	Henry Jenkins,	165
34. —— Beveling Planes,	Harrison W. Lewis,	ib.
35. —— Looms for Piled Fabrics,	Charles A. Maxfield,	ib.
36. —— Making Sugar Candy,	Bartholomew O'Brien,	ib.
37. —— Casting Metals,	Horatio B. Osgood,	ib.

38. Improvement in Buckwheat Fans,	Alfred Platt,	166
39. —— Punching Sheet Metal,	Samuel Lanford,	ib.
40. —— Moulding in Flasks,	Edward Satterlee,	ib.
41. —— Metallic Heddles,	Jacob Senneff,	ib.
42. —— Turning Prisms, &c.,	A. Sherwood and A. Babbett,	ib.
43. —— Splitting Rattans,	Joseph Sawyer,	167
44. —— Mashing Maize,	Frederick Seitz,	ib.
45. —— Planing Machines,	G. W. Tolhurst,	ib.
46. —— Grain Harvesters,	Thomas Van Fossen,	ib.
47. —— Canal Locks,	W. W. Virden,	ib.
48. —— Spring Mattrasses,	John Waters,	168
49. —— Grinding Quartz,	Horatio Blasdel,	ib.
50. —— Churns,	Edwin B. Clement,	ib.
51. —— Drilling Stone,	Henry Goulding,	ib.
52. —— Washing Machines,	John McLaughlin,	ib.
53. —— Printing Presses,	Henry Moesser,	169
54. —— Spinning Machinery,	O. Pearl and H. P. Chandler,	ib.
55. —— Grindstones,	Jesse Pennabecker,	ib.
56. —— Nail Machines,	Samuel G. Reynolds,	ib.
57. —— Brick Kilns,	William Linton,	ib.
58. —— Iron Blinds,	Robert White,	170
59. —— Piano Forte Action,	G. Brown, ass'd to Brown & Munro,	ib.
60. —— Sand Paper Holder,	Azel H. Copeland,	ib.
61. —— Mill Spindles,	Egbert T. Butler,	ib.
62. —— Ring Spinners,	George H. Dodge,	ib.
63. —— Valves for Engines,	W. Few and F. Armstrong,	171
64. —— Cooking Ranges,	John P. Hayes,	ib.
65. —— Water Meters,	Samuel Huse,	ib.
66. —— Nail Plate Feeder,	Caleb Isbister,	ib.
67. —— Iron Railings,	Benjamin Kraft,	ib.
68. —— Railroad Switches,	Abraham S. Miller,	172
69. —— Fire Arms,	Charles V. Nickerson,	ib.
70. —— Shingle Machines,	Luther B. Parker,	ib.
71. —— Ships' Davits,	Charles Perley,	ib.
72. —— Neck Yokes,	John T. Plato,	ib.
73. —— Railroad Switches,	Ira Reynolds,	ib.
74. —— Windlasses,	Amzi C. Semple,	173
75. —— Shears,	John C. Symmes,	ib.
76. —— File Cutting,	James H. Thompson,	ib.
77. —— Making and Sizing Paper,	George W. Turner,	ib.
78. —— Burglar Alarms,	L. J. Warden and E. H. Space,	ib.

RE-ISSUE.

1. Improvement in Planing Machines,	Charles A. Spring and Peter Boon,	174

DESIGNS.

1. For Stoves,	J. G. Abbott and A. Lawrence,	174
2. —— do.,		
3. —— do.,	Sandford Burnam,	ib.
4. —— Spoons,	Henry Hebbard and John Polhamus,	ib.
5. —— Stoves,	William Savery,	ib.
6. —— do.,	J. Harvey Conklin,	ib.
7. —— do.,	J. Wager, D. Pratt, and V. Richmond,	175
8. —— Floor Oil Cloth,	J. Patterson, ass'd to James Allen,	ib.
9. —— Coal Stoves,	J. Burgess, as'd to Geer, Chaffee & Co.,	ib.

February, 1852.

1. Improvement in Hemp Brakes,	Lewis S. Chichester,	175
2. —— Grass Burners,	John A. Craig,	ib.
3. —— Planing Machines,	John Cumberland,	ib.
4. —— Street Sewer,	Willard Day,	176
5. —— Door Spring,	H. Hochstrasser and A. Masson,	ib.
6. —— Gas Purifying Apparatus,	Abram Longbottom,	ib.
7. —— Valves for Engines,	Ephraim Morris,	ib.
8. —— Axletree Arms,	David Phillips,	ib.
9. —— Concentrated Beer,	Franz Reitsch,	ib.

10.	Improvement in Ships' Blocks,	W. & S. G. Coleman,	177
11.	—— Gear of Railroad Car,	Henry Davis,	ib.
12.	—— Gear of Carriages,	Charles F. Verleger,	ib.
13.	—— Steering Apparatus,	Norman W. Wheeler,	ib.
14.	—— Bridges,	Ammi White,	ib.
15.	—— Shoe Brushes,	John Jay Adams,	242
16.	—— Watch Chain Swivels,	Samuel Y. D. Arrowsmith,	243
17.	—— Hose Coupling,	Albigence W. Carey,	ib.
18.	—— Horse Power,	M. H. Cornell,	ib.
19.	—— Grinding Quartz,	Smith Cram,	ib.
20.	—— Preventing Collisions on Railroads,	Thomas A. Davies,	244
21.	—— Grain Harvesters,	Byron Densmore,	ib.
22.	—— Shovel Ploughs,	James H. Forman,	ib.
23.	—— Railroad Switches,	Amos Hodge,	ib.
24.	—— Portable Shower Bath,	Ferdinand Holm,	ib.
25.	—— Grain Harvesters,	William F. Ketchum,	245
26.	—— Measuring Flow of Gas,	William B. Leonard,	ib.
27.	—— Governors,	Ephraim Morris,	ib.
28.	—— Quartz Crusher,	James H. Swett,	ib.
29.	—— Seed Planters,	Edward Wicks,	ib.
30.	—— Dissolving Gold,	Charles F. Spieker,	246
31.	—— Railroad Car Brakes,	B. Holly, as'r to Hewitt, Latham & Co.,	ib.
32.	—— Excavating and Dredging,	C. Willey, Jr., as'r to Willey & Walker,	ib.
33.	—— Furnace Grate Bars,	Francis Armstrong,	ib.
34.	—— Pumps,	Abel Barker,	ib.
35.	—— Blasting Rocks,	Edward Callow,	247
36.	—— Fences,	John Card,	ib.
37.	—— Railroad Gates,	Egbert P. Carter,	ib.
38.	—— Making Chains,	John M. Crawford,	ib.
39.	—— Bran Dusters,	Lewis Fagan,	248
40.	—— Bran Dusters,	Abel Hildreth,	ib.
41.	—— Stop Motion of Looms,	Lora B. Hoit,	249
42.	—— Meter for Steam Boilers,	William H. Lindsay,	ib.
43.	—— Steam Boilers,	James Milholland,	ib.
44.	—— Grain and Grass Harvesters,	Robert T. Osgood,	ib.
45.	—— Grain Threshers,	William R. Palmer,	ib.
46.	—— Banding Pullies,	Robert W. Parker,	250
47.	—— Capstans,	Peter Roberts,	ib.
48.	—— Rotary Cultivators,	Pleasant E. Royse,	ib.
49.	—— Weighing Machines,	W. & T. Schnebly,	ib.
50.	—— Spoons for Medicine,	J. C. Taylor,	251
51.	—— Knitting Machines,	Timothy Bailey,	ib.
52.	—— Cast Iron Car Wheels,	A. G. Bristol and J. C. Jackson,	ib.
53.	—— Eccentric Valve Motion,	John J. G. Collins,	ib.
54.	—— Straw Cutters,	Absalom B. Earle,	ib.
55.	—— Horse Powers,	Horace L. Emery,	252
56.	—— Making Ink,	Alexander Harrison,	ib.
57.	—— Manufacture of Zinc White,	Samuel T. Jones,	ib.
58.	—— Saw Mills,	Oliver B. Judd,	ib.
59.	—— Water Wheels,	J. B. Nott & W. S. Kelly,	ib.
60.	—— Cut Offs,	Frederick E. Seckels,	253
61.	—— Boring Hubs for Boxes,	Henry Sidle,	ib.
62.	—— Gun for Extinguishing Fires,	Hiram Strait,	ib.
63.	—— Cleaning and Weighing Grain,	Thomas T. Strode,	ib.
64.	—— Grain Dryers,	T. E. Weed,	254
65.	—— Floating Docks,	Orrillus T. Williams,	ib.
66.	—— Lightening Vessels,	Orrillus T. Williams,	ib.

DESIGNS.

1.	For Mantel Grate and Summer Piece,	James L. Jackson,	254
2.	—— Do. Do.		
3.	—— Grate Frames,		
4.	—— Do.		
5.	—— Hair Combs,	James Shields,	253

6. For Stoves,	C. Harris & P. W. Zoiner,	255
7. — Lady's Hair Combs,	J. Blackman & C. Skidmore,	ib.
8. — Grate Frame and Summer Piece,	James L. Jackson,	ib.
9. — Stoves,	James Leffel,	ib.
10. — Parlor Stoves,	Vedder & Sanderson, assigned to Warren, Swetland & Little,	ib.
March, 1852.		
1. Improvement in Life Preservers,	Stephen Albro,	298
2. — Steam Boilers,	William Barnhill,	ib.
3. — Grain Dryers,	Henry G. Bulkley,	ib.
4. — Omnibus Registers,	F. O. Deschamps,	ib.
5. — Chairs,	George O. Donnell,	ib.
6. — Cast Iron Car Wheels,	Orson Moulton,	299
7. — Knitting Looms,	William Henson,	ib.
8. — Cotton Presses,	Lewis Lewis,	ib.
9. — Trunk Lock Plates,	Conrad Liebrich,	ib.
10. — Blasting Rocks under water,	Benjamin Maillefert,	ib.
11. — Cast Iron Car Wheels,	Hiram W. Moore,	ib.
12. — Printing Floor Cloths,	Simeon Savage,	300
13. — Horse Power,	Theodore Sharp,	ib.
14. — Bridging Navigable Streams,	Benjamin F. Lee,	ib.
15. — Friction Clutches,	Girard Sickels,	ib.
16. — Suspenders for Garments,	Harris H. Tinker,	ib.
17. — Brick Machines,	Samuel L. Speissegger,	301
18. — Camphine Lamps,	Isaac Van Bunschoten,	ib.
19. — Variation Compasses,	J. R. St. John, ass'd to St. John Compass & Log Co.	ib.
20. — Flour Bolts,	Samuel Cook,	ib.
21. — Water Gauge of Boilers, &c.,	Benjamin Crawford,	ib.
22. — Corn Shellers,	William Linsley,	302
23. — Canal Lock Gates,	Charles Neer,	ib.
24. — Seed Planters,	Ira Reynolds,	ib.
25. — Hay Rakes,	Jay S. Sturges,	ib.
26. — Melodeons,	A. L. Swan,	303
27. — Iron Fences,	John B. Wickersham,	ib.
28. — Ploughs,	Joshua Woodward,	ib.
29. — Door Knobs,	B. Nott, ass'd to J. P. Pepper,	ib.
30. — Double Plane Irons,	Fordyce Beals,	ib.
31. — Pressure Gauge,	Benjamin Crawford,	304
32. — Carpets,	Thomas Crossley,	ib.
33. — Grate Bars,	Frederick P. Dempfel,	ib.
34. — Sofa Bedstead,	John T. Hammitt,	ib.
35. — Tubes for Philosophical Apparatus,	A. B. Latta,	ib.
36. — Shovel Plough,	James Latimer,	305
37. — Cotton Gins,	Thomas J. Laws,	ib.
38. — Manufacturing Carbonates and Sulphur Compounds,	Charles Lennig,	ib.
39. — Burners for Argand Lamps,	Austin Olcott,	ib.
40. — Cutting Bedstead Screws,	J. Parsons Owen,	ib.
41. — Spinning Machinery,	Horace T. Robbins,	306
42. — Planing Machines,	Daniel Stearns,	ib.
43 — Cupping and Breast Glasses,	William S. Thomas,	ib.
44. — Cards for Jacquard Looms,	S. T. Thomas & E. Everett,	ib.
45. — Hot Air Register,	William Turton,	ib.
46. — Railroad Car Brakes,	Thomas Walker,	ib.
47. — Inhaling Powder,	Ira Warren,	307
48. — Hinges for Stove Doors,	Charles J. Woolson,	ib.
49. — Jack Chain Machinery,	H. Marshall & S. S. Cook, ass'd to J. Bostwich, jr., & E. White.	ib.
50. — Omnibus Steps,	Josiah Ashenfelder,	ib.
51. — Shop Awnings,	William H. Bakewell,	ib.
52. — Stamping Ores,	William Ball,	ib.

53. Improvement in Ploughs,	E. Ball, ass'd to I. N. McAbee,	308
54. —— Friction Primers for Cannon,	William Ball,	ib.
55. —— Felting Cloth,	George G. Bishop,	ib.
56. —— Marine Signals,	Thomas H. Dodge,	ib.
57. —— Planing Machines,	John Howarth,	ib.
58. —— Swingle Trees,	Charles Howard,	309
59. —— Making Cordage,	William Joslin,	ib.
60. —— Flour Packers,	Nathan Kinman,	ib.
61. —— Smut Machine,	Thomas H. M'Cray,	ib.
62. —— Cracker Machine,	John M'Collum,	ib.
63. —— Making Artificial Teeth,	Wm. S. McIlhenney,	ib.
64. —— Paging Books,	S. E. Parrish, ass'd to Clayton & Sons,	310
65. —— Jointing Shingles,	William Stoddard,	ib.
66. —— Air Heating Stoves,	J. M. Thatcher,	ib.
67. —— Making Parafine Oil,	James Young,	ib.
68. —— Sausage Stuffers,	Thomas W. Bailey,	311
69. —— Grinding Ores,	William Ball,	ib.
70. —— Excavating Machines,	Charles Bishop,	ib.
71. —— Trusses,	Frederick M. Butler,	ib.
72. —— Screw Blanks, Rivets, &c.,	John Crum,	ib.
73. —— Razor Strops,	John Demerit,	ib.
74. —— Dredging Machines,	James Hamilton,	ib.
75. —— Rice Hullers,	Peter McKinlay,	312
76. —— Shovel Ploughs,	Washington F. Paget,	ib.
77. —— Electric Whaling Apparatus,	A. Sonnenburg & P. Rechten, ass'd to C. A. Hainaken,	ib.
78. —— Gang Ploughs,	H. Killam & George Valleau,	ib.
79. —— Bedstead Fastenings,	William Shaw,	313
80. —— Rat Traps,	James Sheward,	ib.
81. —— Boring Artesian Wells,	John Thomson,	ib.
82. —— Smoothing Irons,	N. Taliaferro & W. D. Cummings,	ib.
83. —— Candle Wick,	Cornelius A. Wortendyke,	ib.

RE-ISSUES.

1. Improvement in Planing, Tonguing, &c.,	Powell, Barlow & Holden, ass'd to R. G. Eunson,	313
2. —— Dressing Staves,	Isaac Judson,	314
3. —— Powder Proof Locks,	William Hall,	ib.
4. —— Seed Planters,	Marshall J. Hunt,	ib.

DESIGN.

1. For Cooking Stoves,	Samuel M. Carpenter,	314

April, 1852.

1. Improvements in Locks,	Albert Betteley,	366
2. —— Saw Mills,	William C. Bronson,	367
3. —— Bait For Fish,	John T. Buel,	ib.
4. —— Cutting Stone,	John W. Cochran,	ib.
5. —— Closing Doors,	Minard Thurston Cooper,	ib.
6. —— Horse Collars,	Henry B. Latham,	ib.
7. —— Door Knobs,	N. Matthews, ass'd to Edwards, Morris & Matthews,	368
8. —— Coat Forms,	William B. Olds,	ib.
9. —— Moth Traps for Bee Hives,	Ebenezer W. Phelps,	ib.
10. —— Button Studs, &c.,	David Rait,	ib.
11. —— Smut Machines,	Daniel Shaw,	ib.
12. —— Harpoons,	J. D. B. Stillman,	ib.
13. —— Adjustable Eccentrics,	Matthew Stubbs,	ib.
14. —— Grain Separators,	John Thompson,	369
15. —— Boot Jacks,	Sardis Thomson,	ib.
16. —— Seed Planters,	Jesse Urmey,	ib.
17. —— Rails and Car Wheels,	John Valentine,	ib.
18. —— Cultivators,	T. J. Ball & John Post,	ib.
19. —— Drop Punches,	Solomon Andrews,	ib.
20. —— Hinges,	William Baker,	370

21. Improvement in Tonguing Boards,	R. Crosby & H. D. Edgecomb,	370
22. —— Welding Steel, &c., to Cast Iron,	M. Fisher & J. H. Norris,	ib.
23. —— Curvilinear Sawing,	James Hamilton,	ib.
24. —— Making Casks,	Do. do.	ib.
25. —— Weaving Figured Fabrics,	Jenks & Goodyear, ass'd to B. H. Jenks,	371
26. —— Reeling Machines,	Elias and Simon Macy,	372
27. —— Sewing Machines,	Isaac M. Singer,	ib.
28. —— Seed Planters,	B. T. Stowell and A. Marcellus,	ib.
29. —— Opening Boxes,	George C. Taft,	ib.
30. —— Seed Planters,	Francis Vandoren,	373
31. —— Paddle Wheels,	George S. Weeks,	ib.
32. —— Planing Machines,	Joel Whitney,	ib.
33. —— Submarine Augers,	Norman Blake,	ib.
34. —— Mattrasses,	Thomas G. Clinton,	ib.
35. —— Winnowers,	Thomas J. Doyle,	ib.
36. —— Sash Stopper and Fasteners,	Charles C. Felton,	374
37. —— Wheels and Axles of Cars,	A. L. Finch,	ib.
38. —— Keys of Pianos, Organs, &c.,	William F. Furgang,	ib.
39. —— Capping of Screws,	Charles T. Grilley,	ib.
40. —— Drawing Spikes,	Daniel Hale,	375
41. —— Raising Water,	N. H. Lebby,	ib.
42. —— Refrigerators,	Andrew Maish,	ib.
43. —— Brick Machines,	Jesse Samuels,	ib.
44. —— Rotary Pumps,	H. C. Spalding and G. Stickney,	ib.
45. —— Balance Gates,	William C. Van Hoesen,	376
46. —— Tailors' Measures,	William T. Wells,	ib.
47. —— Hame Tugs,	R. B. Whipple,	ib.
48. —— Reflecting Level and Square,	Francis Wilbar,	ib.
49. —— Casting Circle Plates, &c.,	N. Matthews, ass'ed to Edwards, Morris & Matthews,	ib.
50. —— Railroad Car Brakes,	Benjamin Kraft,	ib.
51. —— Steam Engine Valves,	Matthias W. Baldwin,	377
52. —— Cutting Files,	John Cust Blair,	ib.
53. —— Shuttles for Hair Cloth, &c.,	Daniel L. Dewey,	ib.
54. —— Hold-Back for Sleds,	Perry Dickson,	ib.
55. —— Smut Machine,	John M. Earls,	ib.
56. —— Steering Apparatus,	Nathaniel T. Edson,	378
57. —— Railroad Switches,	John F. Klein,	ib.
58. —— Cotton Gin,	C. Willey, Jr., ass'd to Willey & Walker,	ib.
59. —— Warm Air Furnace,	A. Kelsey, assigned to J. Cowles,	ib.
60. —— Pressing Tobacco,	E. Parker, assigned to A. A. Parker,	ib.
61. —— Boiler Flue Braces,	A. Lamb and W. A. Summers,	379
62. —— Brushes,	Freeman Murrow,	ib.
63. —— Steam Boiler Gauges,	Thomas J. Sloan,	ib.
64. —— Self-Loading Cart,	B. T. Stowell,	ib.
65. —— Steering Apparatus,	A. Swingle and N. Hunt,	380
66. —— Boxes for Journals,	Henry Turner,	ib.
RE-ISSUES.		
1. Improvement in Smelting Iron Ore,	J. Augustus Roth,	380
2. —— Washing Machine,	James T. King,	ib.
3. —— Car Brakes,	John Lahaye,	ib.
DESIGNS.		
1. For Cooking Stoves,	A. J. Gallagher and J. J. Baker,	381
2. —— Do. Do.	J. J. Savage, ass'd to Morrison & Tibbitts,	ib.
3. —— Do. Do.	S. H. Sailor, as'd to North, Harrison & Co.	ib.
4. —— Portable Furnace,	J. G. Abbot & A. Lawrence,	ib.

Alluvial Formations, &c., of the S. E. Coast of England, 296
America, and her Trial Trip—Notes on the Steam Tow Boat 68
American Steamers—Notice of English Remarks on British and 47
Anthracite and Bituminous Coal for Generating Steam—Comparative Value of 418
———— Coal as Fuel—On adapting Locomotives to the use of 142
Appletons' Dictionary of Machines, Mechanics, &c.—Notice of 72, 215

Arabia—Launch of the Royal Mail Steamship, . . 117
Arrogant—Remarks on H. B. M. Screw Steam Frigate, . 315
Artificial Leech—Notice of a new form of Cupping Glasses and . 286
——— Leg—Notice of J. Russell's 213

Bakewell (T.)—Account of the Explosion of the Steamer Redstone, . 413
Battin *vs.* Taggert, Law Case—On the Coal Breaker of . 96
Beams—Investigation of Strains upon the Diagonals of Lattice . 148

Bibliographical Notices.
Appletons' Dictionary of Machines, Mechanics, &c., . . 72, 215
Bartol's Marine Boilers of the United States, . . 144
Graham's Elements of Chemistry, . . . 360
Light Houses of the United States—Report on the . . 216
Microscopist. By Dr. Joseph Wythes, . . . 288
Naval Dry Docks of the U. States. By C. F. Stuart, Eng. in Chief, U. S. N., 432
Templeton's Engineer, Millwright, and Mechanic's Pocket Companion, 288
Blast Iron Furnaces—On Potash Salts in Soot from . . 392
Blowing Engine at High Velocities—On a new . . 32
Boats and Ships—On the Principles which should regulate the forms of 112, 191, 355
Boilers of the Steam Ship Fulton—Notes on the . . 195
——— United States—Notice of Bartol's Marine . . 144
Bricks used by the Romans—Specimen of Hollow . . 372
Bridge over the Wye—Description of Brunel's . . 12
Brilliant—Account of the Explosion of the Steam Boat . 322
British and American Steamers—Notice of English Remarks on . 47

Calculator of Surface—Sang's Planometer, or Self-Acting . 238
Caloric Engine—Notice of Ericsson's . . . 419
Cement at the Great Exhibition—Experiments on . . 63
Chemistry—Notice of Graham's Elements of . . . 360
Cincinnati Packets and other large Steam Vessels on the Ohio River—Dimensions and Computations of the Pittsburg and . . . 332
Cisterns and Tie Rods—Experiments on the Strength of . 361
City of Manchester—Notice of the Screw Propeller . . 40
——— Norfolk—Description of the Steamer . . 276
——— Pittsburg—Remarks on the Screw Steam Ship . . 178
Coal for Generating Steam—Comparative Value of Anthracite and Bituminous 418
—— Mined in Pennsylvania—Statistics of the . . 71, 143
Collodion Process in Photography . . . 205
——— ——— for Precipitating the Cotton contained in . . 206
Combustible called Charbon de Paris—Report on a new . 284
Cornish Engines—Performance of . . . 207, 355
Creosote—On the Preservation of Timber by . . 145
Cupping Glasses and Artificial Leech—Notice of a new form of . 286

Drainage of Haarlem Meer—Progress made in the . . 365
——— Towns—Water Supply and . . . 1, 73
Dry Dock and Railway at Philadelphia—Notice of the Naval . 420
—— Docks of the U. States—Notes of the Naval . . 432

Electricity—Experiments on the Conducting Power of Wires for Voltaic . 29
Electro-Magnetic Engine—Use of Electro-Magnets made of Iron Wire for the 35
——— Motor of Fessel . . . 406
Engine for Iron Furnaces at high Velocities—On a new Blowing . 32
——— Notice of Ericsson's Caloric . . . 419
Engines—J. V. Merrick's Remarks on the Friction of Marine . 132
Engineer, Millwright, and Mechanic's Companion—Notice of Templeton's . 288
England—On the Alluvial Formations, &c., of the S. E. Coast of . 296
Espy (J. P.), or to Meteorologists in general—Dr. Hare's Queries to Prof. . 325
Explosion of a Steam Boiler in New York, . . 353
——— the Steamboat Brilliant, . . . 322
——— Mary Kingsland, . . . 415
——— ——— Pocahontas, . . . 406
——— of Steam Boilers—On the causes of the . . 422
——— Steamer Glencoe, . . . 414
——— Redstone, ... 413

Fire—On a Law for the Protection of Buildings from . . . 143
——— Ventilating by the Parlor 6
Fulton—Notes on the Boilers of the U. S. Steam Ship . . 195
——— Trial Trip " " . . . 122
——— Performance at sea of the . . . 398
Furnaces—On a new Blowing Engine at high velocities for . . . 32
——— Potash Salts in Soot from Blast Iron . . 392

Franklin Institute.
Proceedings of the Monthly Meetings, . 69, 141, 208, 285, 358, 430
School of Design for Women—First Annual Report of . . . 208
Standing Committees—Appointment of the . . . 212
——— Chairmen and Meetings of the . . . 286
Committee on Science and the Arts.
Report on the Roof of Dr. McDowell's Church, . . . 286

Gas Burner—Experiments on Dr. Goddard's Modification of . . 70
—— Improvement in the Manufacture of . . . 130
—— To Increase the Illuminating Power of . . . 205
—— Works—Extracts from the Engineer's Report of the Philadelphia . 385
——— in Great Britain—Statistics of . . 397
Glasgow—Notes on the Screw Propeller . . . 41
Glass—On Planing Iron and Casting of . . . 207
——— Process for obtaining Photographic Pictures on . . 120
Governor for Water Wheels—Finlay's Regulator or . . 118
Graham's Elements of Chemistry—Notice of . . . 360
Guthrie (A.)—On the causes of the Explosion of Steam Boilers. 422

Haarlem Meer—Progress in the Drainage of . . . 365
Hare (Dr.) Queries to Prof. Espy and to Meteorologists in general, . 325
Hollow Bricks used by the Romans, . . . 372
Holyhead Steamers, ... 126

Ice Grade—Notice of a Railroad upon an . . . 160
Iris—Notes on the U. S. Steamer . . . 42
Iron and Casting of Glass—Planing of . . . 207
—— Furnaces—Potash Salts in Soot from Blast . . 392
—— Joists—Experiments on the Strength of Wrought or Rolled . 80
—— Tie Rods—Experiments on the Strength of Cisterns and . 361
—— Water Pipes—Practical Rule for finding the thickness of Cast . 51
Isherwood (B. F.)—Notice of the U. S. Steam Tug John Hancock, . 400
———Notes on the U. S. Steamer Iris, . . 42
———Vixen, . . 263
———On the Boilers of the U. S. Steamship Fulton, . 195
———Notes on the U. S. Steamship City of Pittsburg, . 178
———H. B. M. Steam Frigate Arrogant, . 315
———Performance of the Steamship San Jacinto, . 393
———Fulton, . 398
———Trial Trip of the Steamship San Jacinto, . 201
———Fulton, . 122

Jones (A. C.) Account of the Explosion of the Steamboat Brilliant, . 322
——— Mary Kingsland, 415
——— Pocahontas, . 406

Lattice Beams—Investigation of the Strains upon the Diagonals of . 148
Launch of the Royal Mail Steamship Arabia, . . . 117
Law Reports of Patent Cases.
Battin vs. Taggart—Infringement on Coal Breakers, . . 96
Winans vs. Troy and Schenectady Railroad Co.,—Infringement of 8 wheel Railway Car, ... 256
Leech—Notice of a new form of Cupping Glasses and Artificial . 286
Light Houses—I. W. P. Lewis' Model of, and Remarks on . 214
——— of the United States—Notice of the Report on the . 216
——— Extracts from . " . 232, 289
Locomotive Engines adapted to the use of Anthracite as a fuel, . 142

Magnetic Motor of Fessel—On the Electro- . . 406

Magnets made of Iron Wire for the Electro-Magnetic Engine—Electro- . 35
Manometer, &c., for Measuring Pressure and Temperature—A new Metallic 102
Marine Boilers of the United States—Notice of the . . 144
——— of the United States—On the Steam . . 135
——— Engines—J. V. Merrick on the Friction of . . 132
——— Propulsion—J. V. Merrick's Reply to J. W. Nystrom on . 270, 417
——————— J. W. Nystrom's Reply to J. V. Merrick on . 349
——— Steam Force of Great Britain, . . . 100
Mensuration—Rules for Solid 240
Merrick (J. V.) on the Propeller and Engine of the Steamship San Jacinto, 50
——————— Steamboats of the Western Waters of the U. S. . 344
——————— Notes on the Steamship State of Georgia, . 407
——————— On the Friction of Marine Engines, . . 132
——————— Reply to J. W. Nystrom on Marine Propulsion, . 270
Metals from the United Kingdom—Export of . . . 194
Meteorological Observations made on the Pyrenees, the Mountains of Province, and the French Alps, ... 381
Meteorologists in General—Dr. Hare's Queries to Prof. Espy, or to . 325
Microscopist, or a Manual on the use of the Microscope—Notice of the . 288
Morris (E.)—Notice of a Railroad upon an Ice Grade, . 160
——————— Rules for Solid Mensuration, . . . 240

Naval Dry Docks of the U. States—Notice of the . . 432
Navigation—English and American Propellers for Atlantic . 111
Navy of the United States—Steam . . . 126
New York—Explosion of a Steam Boiler in . . 353
——————— Ship Building in 112
Nystrom's (J. W.) Reply to J. V. Merrick on Screw Propellers, . 198
——————————————— Marine Propulsion, . 318

Overfalls—On the Discharge of Water over Weirs and . 149, 227

Paddle—Trial of Stevens' Patent Fan . . . 264
Paris Coal—Extract from a Report on a new Combustible, called . 284
Parlor Fire—On Ventilation by the . . . 6
Philadelphia and Reading Railroad—Extract from Annual Report on the 217
Photographic Images—On the Production of Instantaneous . 137
——————— Pictures on Glass—Process for Obtaining . . 120
Photography—The Collodion Process in . . 205
——————— Use of Gutta Percha in . . . 206
Pipes—Practical Rules for finding the Thickness of Cast Iron Water . 51
Pittsburg and Cincinnati Packets and other Large Steam Vessels on the Ohio River—Dimensions and Computations of the . . 332
Planometer or Self-acting Calculator of Surface—Description of Sang's . 238
Potash Salts in Soot from Blast Iron Furnaces, . . 392
Pressures and Temperatures—A New Metallic Manometer for Measuring . 102
Propeller and Engine of the Steamship San Jacinto—J. V. Merrick on the 50
——————————————— J. W. Nystrom on the . 198
——————— Steamship S. S. Lewis—Remarks on the . . 128
Propellers for Atlantic Navigation—English and American . . 111
Railroad Bars—On the Manufacture of . . 142
——————— Extracts from the Annual Report of the Philadelphia and Reading . 217
——————— upon an Ice Grade—Notice of a . . 160
Railway at Philadelphia—Notice of the Naval Dry Dock and . 420
Refraction—Remarks on Unequal . . . 56
Rods—Experiments on the Strength of Cisterns and Tie . . 361
Roof of Dr. McDowell's Church—Report on the . . 286

Screw Propeller City of Manchester—Notes on the . . 40
——————————— Pittsburg—Remarks on the . . 178
——————————— Glasgow—Notes on the . . . 41
——————————— San Jacinto—Notice of the Trial Trip of the . 201
——————————————— from Norfolk to Cadiz—Performance of the . 393
——— Propellers—J. W. Nystrom's Reply to J. V. Merrick's Remarks on 198
——— Steam Tug John Hancock—Notice of the . . 400

Sea Worm on Timber and the best means of Protection—Action of the . . . 38
Ship Building in New York, ... 112
Ships—On the Principles which should regulate the Forms of Boats and . . 112, 191, 355
Snow Phenomena, ... 207
Soot from Blast Iron Furnaces—Potash Salts in 392
Statistics of Great Britain—Commercial 203
Steam Boat Brilliant—Account of the Explosion of the . . . 322
———— Mary Kingsland—" " 415
———— Pocahontas, " " 406
—— Boats of the Western Waters of the U. States—J. V. Merrick on the . . 344
—— Boiler in New York, ... 353
—— Boilers—On the cause of the Explosion of 422
——, Comparative Value of Anthracite and Bituminous Coal for Generating . 418
—— Engine of the San Jacinto—Remarks on the Propeller and the . . 50
—— Force of Great Britain—The Marine 100
—— Marine of the United States, ... 135
—— Navy, " " 126
—— Screw Frigate Arrogant—Remarks on H. B. M. . . . 315
—— Ship Arabia—Launch of the Royal Mail 117
———— Fulton—Trial Trip of the United States . . . 122
————————Notes on the Boilers of the . . . 195
————————Performance at Sea of the . . . 398
———— S. S. Lewis—Remarks on the Propeller of the . . . 128
———— State of Georgia—Notes on the . . . 285, 407
—— Towboat America and her Trial Trip—Notes on the . . . 68
—— Vessels on the Ohio River—Dimensions and Computations of the Pittsburg and Cincinnati Packets, and other large . . . 332
Steamer City of Norfolk—Description of the 276
——— Glencoe—Account of the Explosion of the . . . 414
——— Herman—Notice of Breaking the Shaft of the . . 431
——— Iris—Notes on the United States . . . 42
——— Redstone—On the Explosion of the 413
——— Vixen—Notes on the United States . . . 263
Steamers—Notice of English Remarks on British and American . . 47
———— The Holyhead 126
Strains upon the Diagonals of Lattice Beams—Investigation of the . . 148
Sub-Marine Telegraph, ... 162-364

Telegraph—Lectures by Dr. Turnbull on the . . . 57, 104, 182, 278, 336
———— Sub-Marine 162, 364
Temperatures—Manometer for Measuring Pressures and . . . 102
Tie Rods—Experiments on the Strength of Cisterns and . . 361
Timber and best means of Protection—Action of Sea Worms on . . 38
——— by Creosote—On the Preservation of . . . 145
———, On Seasoning 53
Tornadoes and Water Spouts—Dr. Hare's Queries Respecting Causes of . 328
Towns,—Water Supply and Drainage of 1, 73
Trautwine (J. C.)—Rule for finding the thickness of Cast Iron Water Pipes. 51

Ventilation by the Parlor Fire, ... 6
———— of Buildings—On a Law Regulating the . . . 143
Vixen—Notes on the United States Steamer 263
Voltaic Electricity—On the Conducting Powers of Wire for . . 29

Water Pipes—Rule for finding the Thickness of Cast Iron . . . 51
——— Spouts—Dr. Hare's Queries Respecting Tornadoes and . . 328
——— Supply and Drainage of Towns, ... 1, 73
——— Wheels—Findlay's Regulator or Governor for . . . 118
Weirs and Overfalls—On the Discharge of Water over . . . 149, 227
Wire for the Electro-Magnetic Engine—Use of Electro-Magnets made of Iron 35
Wires for Voltaic Electricity—On Conducting Powers of . . . 29
Worm on Timber, and best means of Protection—Action of the Sea . . 38

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